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Botanical recording, distribution maps and species frequency

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ABSTRACT

A standardised botanical survey technique was used to investigate sources of variation in botanical surveys used to produce distribution maps and assess species frequency. The most significant sources of variation between visits were the individual botanists; the number of habitats visited and length of route recorded also explained some variation. The number of records for each species increased proportionally with the amount of recording as species were encountered in essentially a random manner. The results demonstrate that as recording for atlas projects is unlikely to be comprehensive, care should be taken to obtain even coverage and minimise the variations in recording. Recommendations to improve the quality of atlas data are given.

KEYWORDS: Atlas maps, botanical surveys, plant distribution.

INTRODUCTION

Detailed information on the distribution of plants in Britain has been published for over 300 years. The quality of the information available has changed from simple lists of localities (e.g. Ray 1689), to catalogues of vice-counties (Watson 1883), or more recently to the "dot" maps such as those in the *Atlas of the British flora* (Perring & Walters 1962) and county tetrad (2 km × 2 km square) atlases (e.g. Hall 1980; Philp 1982) based on grid systems of different sizes. The use to which such data have been put has also changed from simple curiosity to phytogeography, and more recently to applied nature conservation and environmental impact assessment.

Dot maps are currently the popular means of presenting information about plant distributions. The grid systems delimit the areas to be recorded, and the resulting species distribution maps allow simple comparisons of species' distributions with environmental variables such as climate or soil types. They also provide information which has been used to assess frequency, especially rarity. For instance, nationally rare plants are those which occur in 1–15 hectads (10 km × 10 km squares) in the *Atlas of the British flora*, and nationally scarce species are those which occur in 16–100 hectads (Nature Conservancy Council 1989). Similar systems have also been applied at a county level; species with five or fewer tetrad records in Sussex (Hall 1980) are termed "very rare", those with 6–20 records are "rare", and so forth.

An assumption of using dot maps to assess frequency is that the number of dots estimates the frequency of the plant, and it is generally accepted that overall, the more records for a species, the more common it is likely to be. However, as the surveys for national or county atlases are not comprehensive, the number of dots is a relative and not an absolute estimate of frequency. Dot maps also give no indication of the actual number of plants, or, more importantly for conservation, of populations, since any one dot may represent anything from one plant or population to many thousands.

A second common assumption is that atlas data are equally representative of all species. Recent work has shown that this assumption cannot be justified as the recording behaviour and ability of individual botanists, the types of plants being recorded, and the survey techniques used, all give rise to marked variations in the number of records obtained for different species (Rich & Woodruff 1992).

The recorders who collect the data markedly affect the number of records. In many atlases, hectads or tetrads are usually allocated to individual recorders, and the differences in effort and expertise between recorders may result in localised concentrations of records or under-recorded areas. For instance, the area around the Moray Firth in Scotland was well recorded for the *Atlas of the British flora*, whilst South Wales was very under-recorded (Rich & Woodruff 1990). Similarly, the repeated concentrations of tetrad records within the same hectad boundaries for families such as Polygonaceae or Poaceae in Shropshire (Sinker *et al.* 1985) can only be due to recording. It is a common experience that most botanists know some species better than others, and Woodell (1975) demonstrated that independent visitors add significantly more species than repeat visits by the same recorder.

In some surveys where coverage is poor, the distribution maps are more representative of the distribution of recorders rather than of the species. This is well known for critical genera such as *Taraxacum* or *Rosa* (e.g. Graham & Primavesi 1993), and is probably also partly true for many other "difficult" groups such as some grass genera, or even conspicuous spring-flowering species such as *Anemone nemorosa* L. in remote areas (Rich & Woodruff 1990, 1992).

The time spent recording strongly affects the number of species found (Rich & Woodruff 1990, 1992). It is difficult to know how long should be spent recording to obtain reasonable coverage, and most atlases are recorded on an ad hoc basis with little attempt to control how much recording is actually done. Generally, the recorders carry on recording until they run out of time, or the law of diminishing returns comes into play and they feel further recording would be better directed to another area to improve overall coverage.

Interpretation of frequency also depends on the scale at which it is measured. For instance in Kent, *Ranunculus lingua* L. and *Teesdalia nudicaulis* R. Br. have both been recorded from 15 tetrads (Philp 1982). The former, with a widespread, more or less random, scatter of records had been recorded from eleven hectads. The latter, which has a clumped distribution centred on Dungeness, has only been recorded from three hectads. This also shows that the type of distribution shown by a plant can also affect the number of records; the frequency of plants with dispersed distributions may be relatively over-represented compared to those with clumped distributions.

There are two main ways to provide good, comparative atlas data. First, record all areas comprehensively so that the records are independent of the botanists. This is the ideal approach but is impractical for anything more than very small areas, and requires large resources and botanists of consistently high quality. Also, as the actual number of species present in an area is not known, judgement of what is "comprehensively recorded" is usually subjective. From the experience of studies which have been assessed using the species-area relationship, comprehensive coverage is unlikely to be achievable; Dony (1976) managed 86% coverage for the *Bedfordshire plant atlas* and Rich & Woodruff (1990) found 49% coverage for the *Atlas of the British flora* (Perring & Walters 1962) and 56% for the B.S.B.I. Monitoring Scheme.

Second, use a standardised survey method where recording bias is minimised and equal effort is put into each area. Although the records are accepted from the outset as not comprehensive, the relative species frequencies should be representative of the flora as a whole provided equal treatment is given to all. Good comparable coverage can be obtained even with botanists of varying abilities, and a defined recording target is a useful incentive. There have been few attempts at standardised surveys. Good (1948) carried out a standard site survey in Dorset. The B.S.B.I. Monitoring Scheme was a standardised sample survey of Britain and Ireland but returned far from uniform coverage (Rich & Woodruff 1990). A standardised 1-km square survey, the *Flora of Ashdown Forest* (Rich *et al.*), is currently in preparation using experience gained from the results of the work presented in this paper.

Given the ad hoc basis of recording for most atlases, there has also been surprisingly little analysis to assess how representative the atlas data are, how they are affected by variations in recording, or how reliable the numbers of records are as an indication of the frequency of a species. A number of techniques have been developed to try to smooth the results of incomplete surveys (e.g. Le Duc, Hill & Sparks 1992; Osborne & Tigar 1992), but there have been few studies of how to improve the quality of the original data (e.g. Woodell 1975).

The object of this paper is therefore to investigate sources of variation in recording by using a standardised survey technique. The method we have chosen is to analyse the variation observed in repeated visits to tetrads, which correspond to the way atlases are currently recorded. In particular,

factors affecting the number of species recorded, the relationships between different recording visits, and the effect of additional recording are addressed. The results are then used to make recommendations for improving the quality of atlas data.

We have chosen not to investigate how the number of species recorded by individuals or groups of botanists varies under standard conditions. There can be little doubt that a pair of botanists will record more than a single botanist, and perhaps three botanists more than two. Botanists should be free to choose their companions as recording is often a social event and must remain rewarding and enjoyable for all.

METHODS

Tetrads SU/8.2 K, L, Q and R (following standard B.S.B.I. tetrad nomenclature; Ellis 1986) were selected for survey near Midhurst, West Sussex (v.c. 13), on 18 and 19 July 1992. The tetrads were selected for convenience of access, the range of habitats present, and because T.C.G.R. knew them intimately and could verify the records. 29 volunteers with a range of botanical abilities representative of many national and county Flora projects recorded on one or both days. The weather was largely dry with light cloud, and did not influence the results.

Tetrad K contained a large area of heathland (Iping Common), areas of conifer plantation and improved farmland; this was selected as a species-poor tetrad for comparison with the other tetrads. Tetrads L and R were species-rich tetrads with pasture, arable, hedges, sunken lanes, semi-natural woodland, the River Rother, and villages. Tetrad Q was intermediate in apparent richness, with conifer plantations, semi-natural broad-leaved woodland, farmland and a disused brickworks and rubbish tip on the edge of Midhurst. All four tetrads had over 300 species recorded in them for the *Sussex plant atlas* (Hall 1980).

To minimise variations due to individual recorders, a standardised recording technique was used. With a few minor exceptions, botanists worked in pairs and recorded for 2.5 hours in each tetrad. For subsequent sessions, individuals were rotated to different tetrads and paired with a different botanist. The recorders selected their own areas to survey within the allocated tetrad and marked the areas recorded on a map, and filled in details on the record cards designed to collect information about the recording. The length of the route searched (which gives an estimate of the total area covered) and the number of habitats recorded were noted. Recorders were asked not to discuss the project in detail during the course of the work.

Most species were identified in the field, but a few specimens were collected and checked by T.C.G.R. and others at the end of the recording sessions. Casuals and obviously naturalized species were recorded, but deliberately planted species were not recorded. Of the critical taxa, data for *Hieracium sabaudum* and *H. umbellatum* were included as they are the two common species known by many southern botanists, but two records of *Rubus procerus* and *R. spectabilis* were excluded from the analysis; no *Taraxacum* microspecies were recorded. The species recorded were checked and analysed in a computer database.

Each recorder was ranked for botanical ability on a scale between 1 (inexperienced) to 5 (experienced) by T.C.G.R., based on his knowledge of their expertise as botanists. A "recording quality score" was calculated for each card by adding the ranks of the two recorders together.

RESULTS

Despite each pair having a map of the tetrads and being aware that the recording was being analysed, two pairs strayed out of their tetrads. It was possible to correct one card, but the other was rejected. Table 1 summarises the general results. A total of 7254 records representing 634 species were collected on 41 cards, of which twelve were obvious errors (0·15% error rate). The number of species recorded per card ranged from 69 to 257. Five species (0·8%) were recorded on every card whilst 155 (24%) were recorded only once. Not every species which was known to be present in the area was recorded, and many species new to each tetrad were found. The routes noted on the maps showed that some parts of each tetrad were covered by several visits, whilst other parts were not visited at all.

TABLE 1. GENERAL RESULTS FROM THE TETRAD SURVEY AT MIDHURST, WEST SUSSEX
Standard errors are given in brackets.

	Tetrad				
	K	L	Q	R	Total
Number of cards	11	10	9	11	41
Total number of records	1727	1807	1642	2078	7254
Mean length (km) of route recorded	3·0 (0·4)	3·2 (0·4)	2·9 (0·3)	2·8 (0·3)	
Mean no. habitats recorded	6·6 (0·9)	7·0 (0·7)	6·1 (0·6)	8·4 (0·6)	
Mean no. species recorded	157 (15·5)	181 (15·8)	182 (12·2)	189 (11·9)	
Mean recording quality	6·0 (0·6)	6·9 (0·5)	7·0 (0·4)	6·5 (0·5)	
Total no. species	404	426	413	428	634

The number of species recorded in an area is determined first by the actual number of species present, and secondly by the recording, which determines which species are actually found. During the survey the number of species was constant for each tetrad, so that differences within tetrads can only be explained by variation in recording. The variation in the number of species recorded was examined in relation to the following four variables:

1. differences between tetrads;
2. differences between recorders;
3. length of recording route; and
4. number of habitats visited.

DIFFERENCES BETWEEN TETRADS

Although tetrad K was chosen because it had large areas of species-poor heathland, there was little difference in the total number of species recorded for each tetrad, and no significant difference in the number of species per card between tetrads (ANOVA, $p = 0{\cdot}43$, d.f. = 40). Similarly there were no significant differences between the tetrads in the number of habitats recorded per card (ANOVA, $p = 0{\cdot}904$, d.f. = 40), or the recording quality score (ANOVA, $p=0{\cdot}549$, d.f. = 40). Hence all further analysis treats the four tetrads as a homogeneous area unless otherwise stated.

FACTORS AFFECTING THE NUMBER OF SPECIES RECORDED

The effect of individual botanists on the number of species is known to be a major source of variation (Rich & Woodruff 1990, 1992). Despite attempts to minimise this, the recording quality score still explained the most variation in the number of species recorded during the 41 visits (Fig. 1; $r^2 = 0{\cdot}506$, $p<0.001$). Both the length of recording route (Fig. 2; $r^2 = 0{\cdot}148$, $p=0{\cdot}017$) and the number of habitats visited (Fig. 3; $r^2 = 0{\cdot}220$, $p=0{\cdot}005$) also explained significant variation in the data. However, these latter two are not independent as the number of habitats visited increased as the length of the recording route increased, and once the number of habitats has been accounted for, the length of recording route contributes little extra in explaining the variation in the number of species found.

RELATIONSHIP BETWEEN RECORDING TRIPS

The cumulative increase in the number of species recorded for the whole area is shown in Fig. 4. Initially the number of species rises rapidly, and thereafter the rate of addition declines as the number of cards increases. With one exception, every card contributed some unique species to this curve. The curve does not reach an asymptote even after 41 recording visits to the whole area, suggesting more species would be found by further recording. A comparison with records published in Hall (1980), Briggs (1990), records held by T.C.G.R., Mrs P. Donovan, F. Rose and species listed in a subsequent exercise in 1993 indicates that at least another 88 species (including spring-flowering species and casuals) have been recorded for these tetrads since 1966.

The 24% of the species which were only recorded once during the survey reflects a real problem for a field recorder trying to get comprehensive coverage. Both rare and common species may be widely scattered and unevenly distributed around each recording area, and the probability of

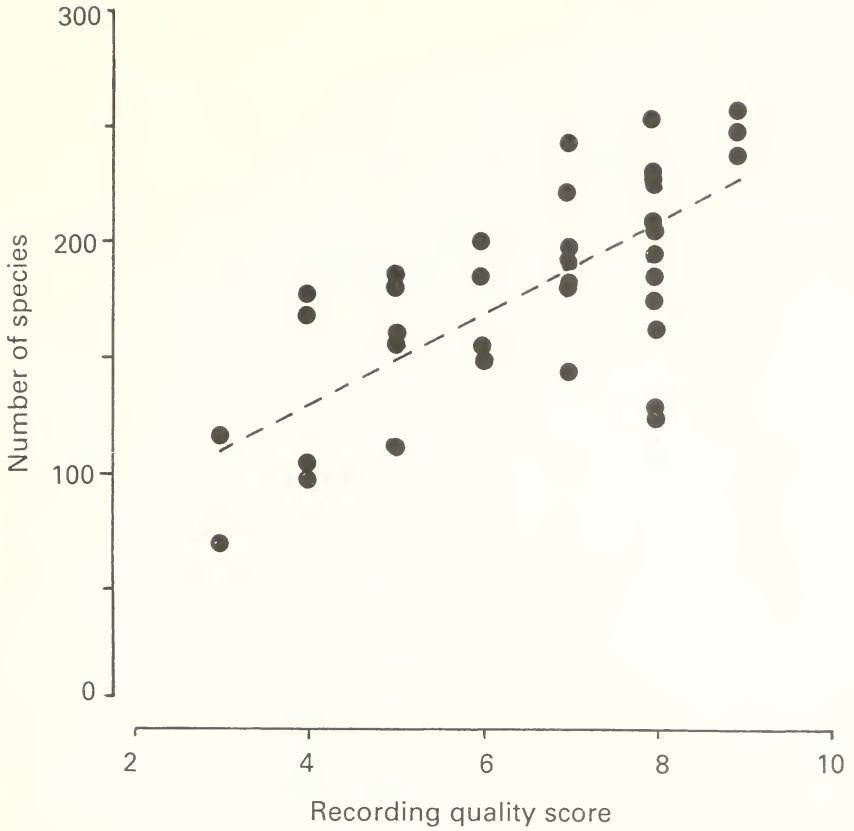

FIGURE 1. Relationship between the number of species recorded and the recording quality score for each card during 41 visits to tetrads at Midhurst, West Sussex. Each botanist was ranked between 1 (inexperienced) and 5 (experienced), and the ranks added together to give the recording quality score (a high score indicates more experienced botanists). A linear regression line is fitted to indicate the variation in the data.

recording them is simply a function of time and ensuring as many habitats and areas are recorded as possible.

As the routes recorded in most surveys overlapped with other visits to the same tetrad, the similarities between surveys were investigated to establish the most efficient way of adding new species. The numbers of species in common between pairs of recording visits in tetrad K, expressed as a percentage of the total number of species recorded from both visits are given in Table 2 (upper right). They range from 16·3% to 55·7% with a mean of 38·1%. As more species in common would be expected if botanists recorded the same route, the percentage of the combined total of the route in common was also calculated (Table 2, lower left), which ranged from 0% to 23·8% with a mean of 6·8%, surprisingly low figures. The percentage of the route in common was a reasonable predictor of the percentage of species in common between visits (Fig. 5; $r^2 = 0{\cdot}172$, $p=0{\cdot}002$).

EFFECT OF FURTHER RECORDING

The effect of doubling the recording effort on the number of species recorded and on the number of records for each species (an estimate of abundance) was investigated. For each species, the number of records from a random sample of 21 cards was compared with the number of records from all 41 cards (Fig. 6). This shows a linear fit ($r^2 = 0{\cdot}958$, $p<0{\cdot}001$), which suggests that the number of records of each species increases proportionately with the amount of recording, and implies that the

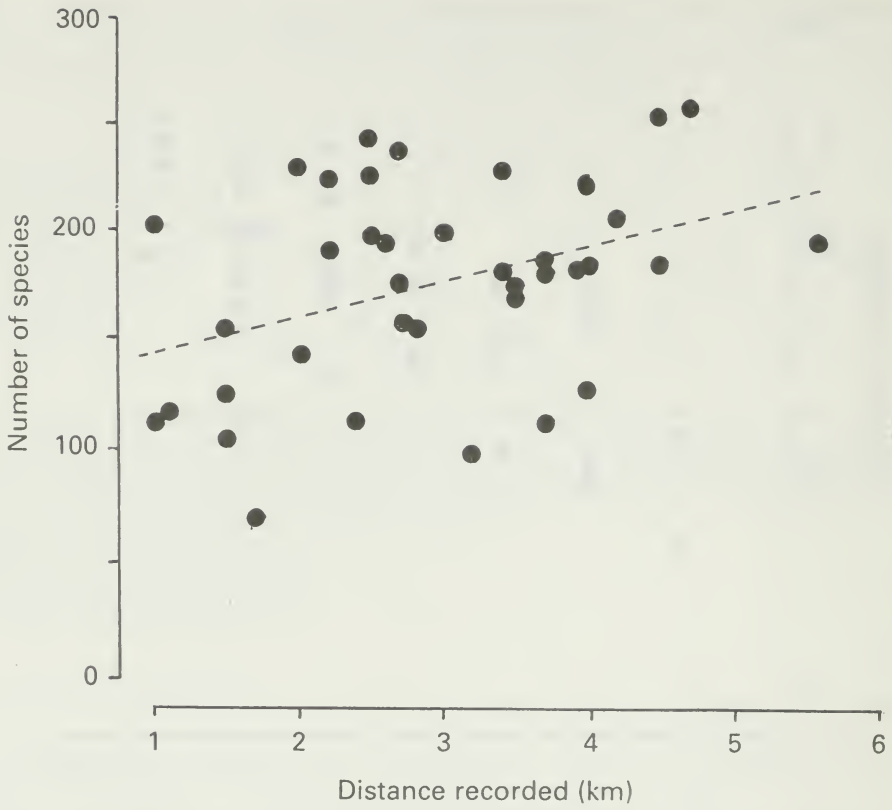

FIGURE 2. Relationship between the number of species recorded and the distance recorded (km) on each card during 41 visits to tetrads at Midhurst, West Sussex. A linear regression line is fitted to indicate the variation in the data.

species are encountered as a random sample from the available pool, and not in any systematic or non-random manner. There is however more variation for rarer species than common species, suggesting that the number of records is a poorer measure of abundance for rarer species than common species.

The data can also be used to see how an increase in recording effort affects the species-abundance distribution. According to Raunkiaer's law (Jaccard 1908; Raunkiaer 1918), there are comparatively many rare (low abundance) species, and possibly comparatively many common (high abundance) species, but relatively few in the middle (medium abundance). As recording (sampling) intensity increases, species "move" from the left of the histogram to the right, whilst maintaining the central dearth of species. This is shown for the random sub-sample and the complete data in Fig. 7. The relationship in Fig. 6 shows that this result is produced when all species are affected equally by the increased recording.

Rich & Woodruff (1990) corrected for differences in recording effort between the *Atlas of the British flora* and the B.S.B.I. Monitoring Scheme using a simple relationship derived from a crude analysis. The 1992 survey provided an opportunity to examine the relationship more rigorously. The effect of further recording on the number of tetrads in which a species was recorded was examined by calculating, for each species recorded in 1, 2, or 3 tetrads from a random sample of 21 visits in all tetrads, the mean number of tetrads in which they were recorded from 41 visits (that is, from doubled recording effort). It is not possible to estimate the mean number of tetrads recorded for species not originally recorded during the 21 visits since it is not known how many more species

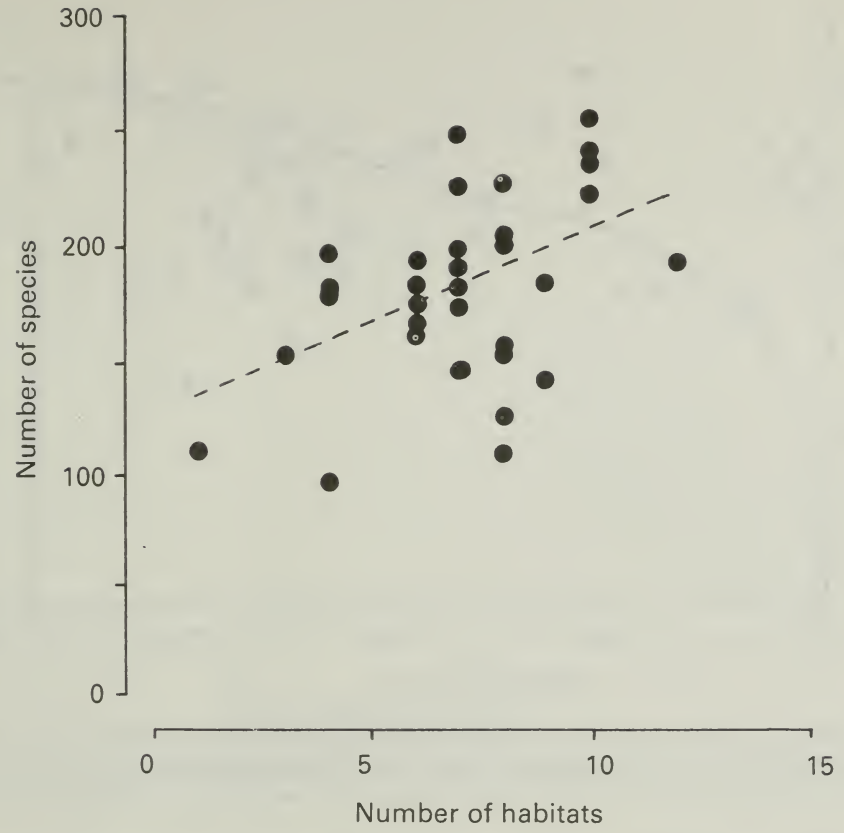

FIGURE 3. Relationship between the number of species recorded and the number of habitats recorded on each card during 41 visits to tetrads at Midhurst, West Sussex. A linear regression line is fitted to indicate the variation in the data.

remain to be discovered. Species already recorded in four tetrads obviously cannot be recorded in more than four tetrads. The results are plotted in Fig. 8, which shows that the number of extra tetrad records tails off as the species become commoner.

DISCUSSION

FACTORS AFFECTING THE NUMBER OF SPECIES RECORDED

The data confirm that, despite efforts to minimise it, the major source of variation was recording by different botanists. Previous work (e.g. Kirby *et al.* 1986; Rich & Woodruff 1990) has already shown that such variation exists even within site surveys, but the scale of the problem exposed here for tetrads was not expected. The actual species recorded may depend on which side of a path is being examined, but the total number of species recorded will depend on the botanist.

One recording episode provided another striking lesson. As Orpine (*Sedum telephium* L.) was thought to occur in only one hedge in the area, T.C.G.R. made a special trip to record the plant, but the hedgerow had been narrowed and fenced, and the plant had gone. A second recorder however had earlier found the plant on a woodland edge 20 m from the original site. Another recorder, overhearing the news, visited the site to see the plant for himself later, but failed to find it. A fourth visit

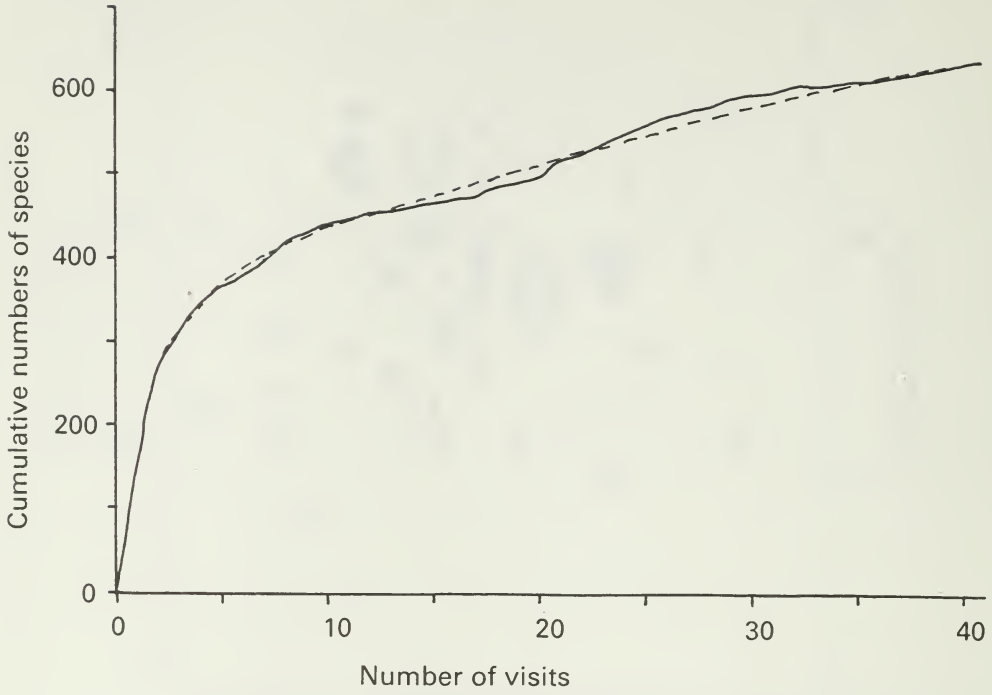

FIGURE 4. Cumulative number of species recorded as cards from additional visits were added (—) from tetrads at Midhurst, West Sussex. A smoothed version of the graph fitted by eye is also shown (– – –).

to double check showed that the plant was indeed present. To have such an obvious species on the edge of a path overlooked on two of the four visits made specially to look for it was very surprising. Failure to find a plant where it had occurred in the past or where it was expected did not mean it was extinct; populations are dynamic, and botanists are not perfect.

Botanists can increase the number of species recorded by training themselves to look for different habitats, remembering to look up at trees, throwing grapnels into ponds, etc. Experience, concentration and a sharp pair of eyes are crucial to good recording, and regularly recording with other botanists can markedly improve the consistency and breadth of knowledge, and impart valuable field-craft skills. The vast majority of species can be recorded routinely by most botanists, but the intrinsic difficulties of recording critical species thoroughly demands that a different approach, such as a systematic sample survey, might be more appropriate.

The relationship between habitats recorded and the number of species corresponds well with the concept of β-diversity, whereby more species are encountered as recorders move into different habitats (Whittaker 1975), and this is the common experience of botanists in the field. There were some difficulties in assessing which habitats had been recorded during the exercise – a few cards had records for plants characteristic of a specific habitat (e.g. ponds), but without that habitat being noted as visited. Also the habitat list on the record card was subsequently found in 1993 to be too simplistic, and even a habitat described as "road verge" would be better listed as a mown verge, unmown verge, disturbed roadside bank, and so forth (data not presented). Consequently, a very detailed list of habitats would need to be listed on the card to collect these data routinely; experience with the Sussex Botanical Recording Society indicates that such lists are usually not filled in but a simple list can be usefully used as an aide-memoire of habitats to record. The length of route recorded is less important than the number of habitats visited, and does not need to be analysed, but the route taken may help indicate other areas to visit or help refind plants in the future.

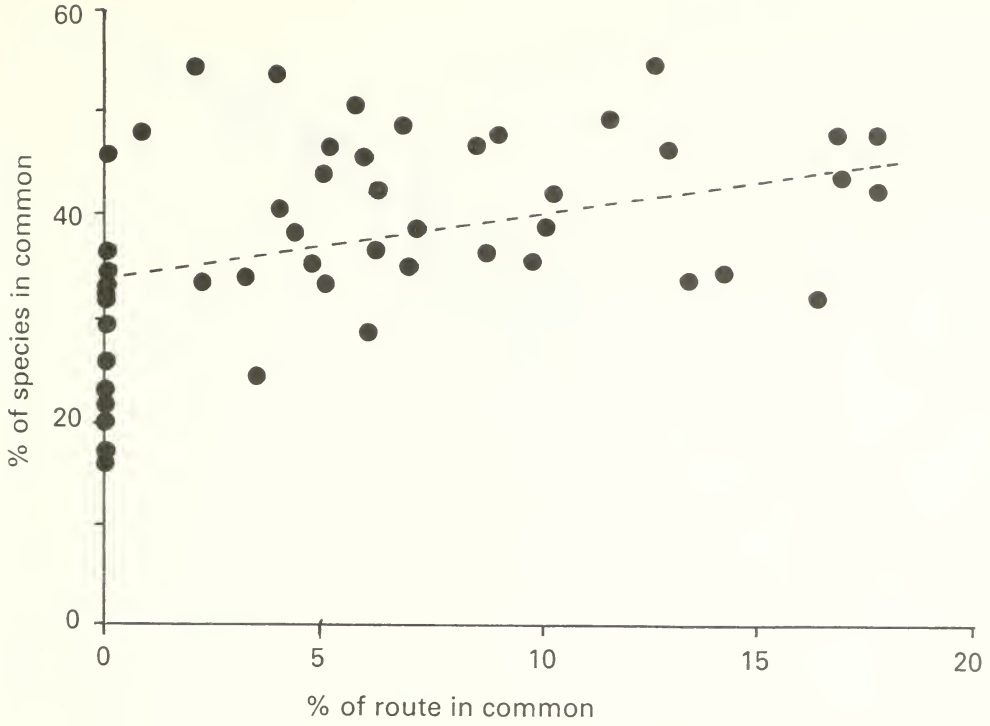

FIGURE 5. Relationship between percentage of route in common and number of species in common for recording visits to tetrad K at Midhurst, West Sussex. A linear regression line is fitted to indicate the variation in the data.

RELATIONSHIP BETWEEN RECORDING TRIPS

The fact that new species were being found in each tetrad after nine to eleven visits and in the four tetrads combined after 41 visits suggests that it is impractical to try to record each tetrad or area comprehensively. The number of species recorded obviously increases with more visits, but most tetrad flora projects are unlikely to achieve even the mean of eight visits required to obtain 90% of the species recorded in each tetrad here. Additional visits at different times of year are also required to record spring and autumn species (Kirby *et al.* 1986), as are visits during different years to account for species-turnover and variations from year to year.

TABLE 2. PERCENTAGES OF SPECIES IN COMMON (UPPER RIGHT) AND ROUTE IN COMMON (LOWER LEFT) FOR 11 RECORDING VISITS TO TETRAD K AT MIDHURST, WEST SUSSEX

Visit	1	2	3	4	5	6	7	8	9	10	11
1	–	54·9	40·6	36·4	23·3	42·2	47·8	42·7	44·1	45·6	48·1
2	12·7	–	38·3	36·4	23·4	38·6	48·7	46·5	45·5	48·0	50·6
3	4·1	4·4	–	33·7	17·6	35·6	33·3	33·8	32·9	35·1	34·2
4	8·8	0	2·3	–	16·3	42·5	31·8	38·9	34·8	32·4	35·4
5	0	0	0	0	–	25·8	20·0	21·8	28·8	25·8	24·5
6	10·3	7·2	9·8	6·3	0	–	29·5	32·2	36·6	33·5	34·6
7	9·1	6·9	5·1	0	0	0	–	48·1	45·7	55·7	46·9
8	17·8	13·0	13·5	10·1	0	16·4	17·8	–	44·0	46·6	48·4
9	5·1	6·0	0	0	6·1	6·3	0	17·0	–	54·3	49·4
10	0	0·9	7·0	0	23·8	0	22·5	5·2	2·1	–	53·5
11	16·9	5·8	3·2	4·8	3·5	14·3	8·5	23·4	11·6	4·0	–

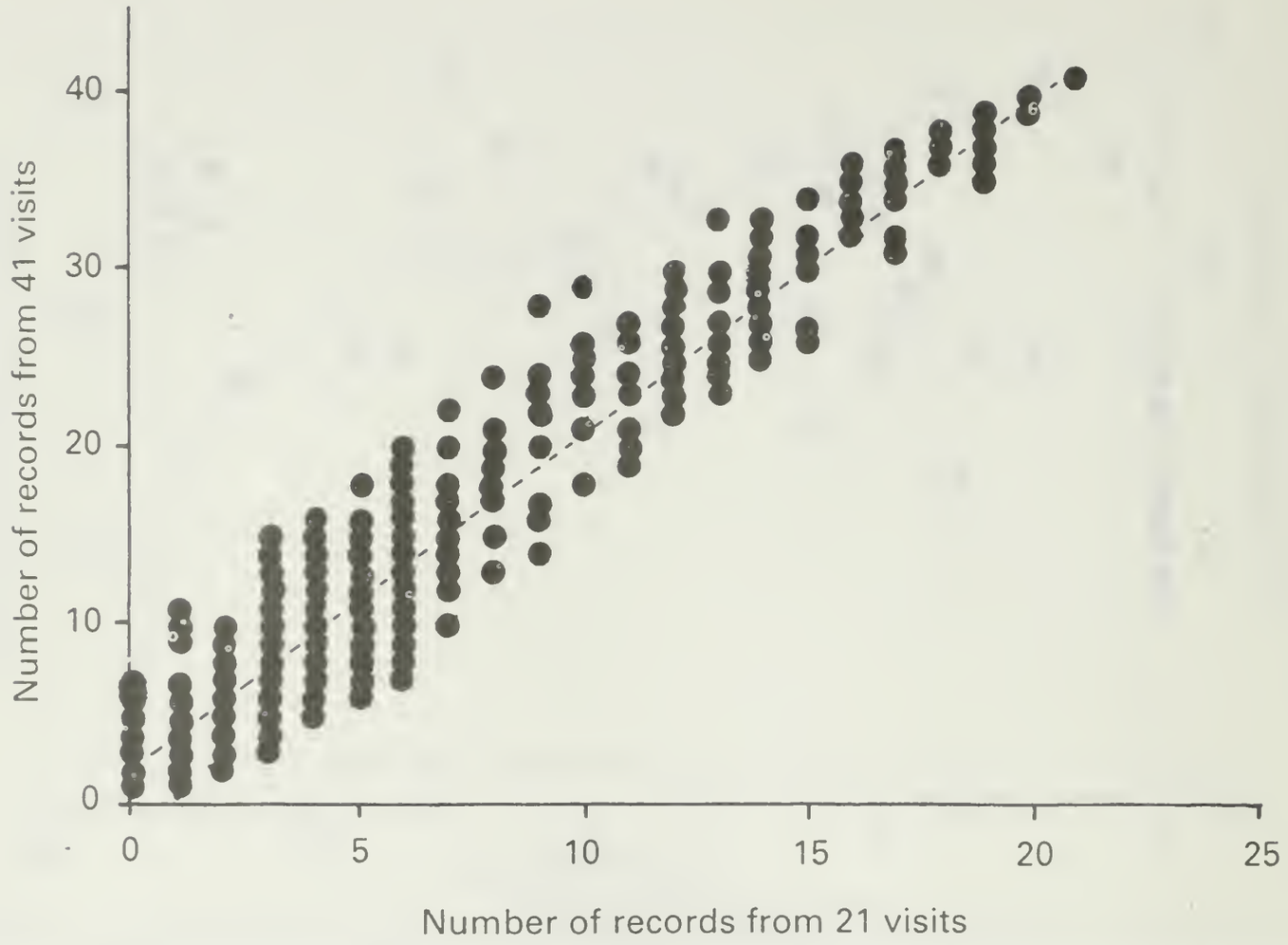

FIGURE 6. Relationship between the numbers of records obtained from a random selection of 21 visits and from all 41 visits (an approximate doubling of recording effort) from tetrads at Midhurst, West Sussex. The regression line (– – –) implies the species are encountered as a random sample from the available pool, and not in any systematic or non-random manner.

The average number of species in common between visits (38%) was lower than the figures of 52% reported by Rich & Woodruff (1990) or of 47% by Woodell (1975) for crudely equivalent surveys. As virtually all cards added species, further visits are to be encouraged to improve the species lists, but it is not possible to say how many visits are required as the actual number of species present is not known, and a general rule for south-east England will not apply in north-west Scotland. The percentage of the route in common was so low (6·8%) that there is little need to direct botanists to different areas at least initially, though a final check that all habitats have been recorded would clearly be of value. This means botanists can be largely left to get on with the recording themselves without detailed directions from a central co-ordinator.

EFFECT OF FURTHER RECORDING

Doubling the recording effort resulted in a proportional increase in the number of records, and the species were recorded in a random manner from the available pool. This indicates that if comprehensive coverage cannot be obtained, then data from a standardised survey can provide comparative data representative of the flora. A standard survey should be based on standard recording effort; some county Flora projects set a target number of species to get even coverage, but this may result in poor areas being relatively well-recorded and richer areas being poorly recorded unless a high target is set. Also if standard surveys are carried out with known (and documented) recording effort, then it should be possible to correct the results relative to each other to assess change even if the amount of effort varied between surveys. The analysis of numbers of tetrads recorded for each species in 21 and 41 visits indicates that the model used to correct the *Atlas of the British flora* B.S.B.I. Monitoring Scheme data (Rich & Woodruff 1990) was acceptable.

FIGURE 7. Histograms showing the number of records ("abundances") obtained from tetrad records from Midhurst, West Sussex: Upper histogram, random sub-sample of 21 cards; Lower histogram, all 41 cards. The change in the number of records in each class shows that as recording (sampling) intensity increases, species "move" from the left of the histogram to the right, whilst maintaining the central dearth of species (Raunkiaer's law).

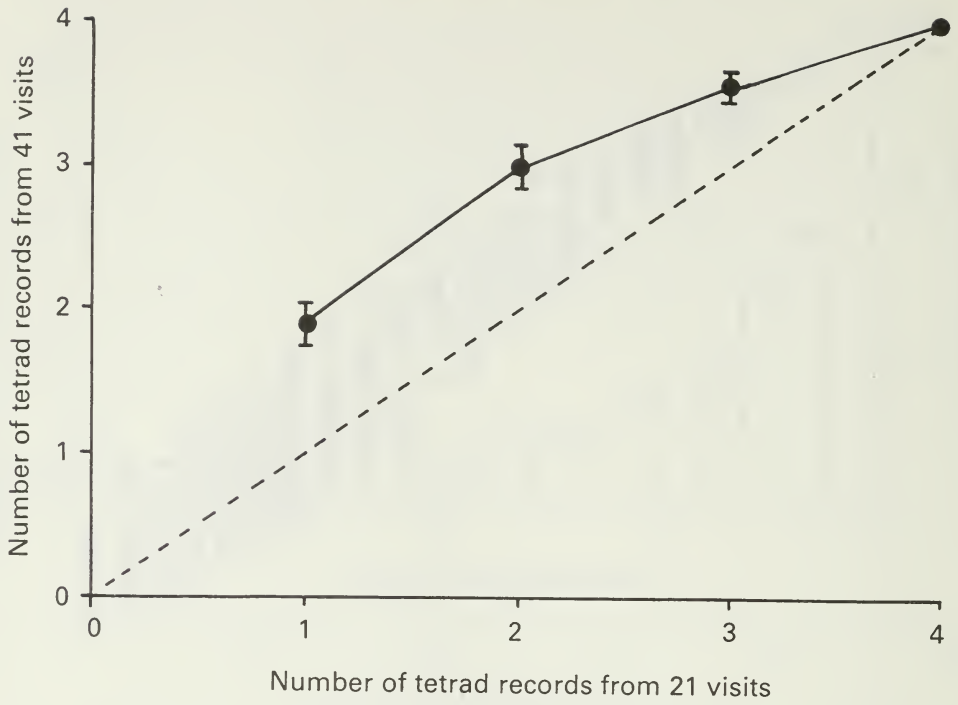

FIGURE 8. Number of tetrad records (mean ± twice the standard error) from 21 visits plotted against number of tetrad records from 41 visits to tetrads at Midhurst, West Sussex. It is not possible to estimate the mean number of tetrads recorded for species not originally recorded during the 21 visits since it is not known how many more species remain to be discovered. A 1:1 relationship is also shown (– – –).

CONCLUSIONS AND RECOMMENDATIONS

Overall, the results demonstrate that if care has been taken to obtain even coverage the numbers of records should be a reliable indication of the frequency of a species. If coverage is not comprehensive or not systematic, significant variations will be introduced by the recorders which will affect the dot maps.

It is also worth reiterating that data on the recording such as time spent recording, number of visits, etc. should be routinely collected and presented with the species records to aid in their interpretation (Rich & Woodruff 1990).

It is therefore recommended that future atlas projects should attempt to obtain systematic, even coverage so that data can be used for other purposes. The best ways to improve the quality of the basic data within the constraints imposed by using volunteers (critical species may require a different approach) are as follows:

1. improve the recording ability of the botanists, by training in identification skills and field-craft, and through contact with other botanists;
2. encourage recorders to visit many different areas rather than concentrate on one area;
3. try to achieve even coverage by recording for the same number of hours or having the same number of visits in each tetrad;
4. visit as many habitats as possible in each square, note which habitats have been recorded and try to ensure all are visited during the course of the work; and
5. ensure adequate seasonal coverage (e.g. Rich & Woodruff 1992).

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Pulmonaria obscura Dumort. (Boraginaceae) in Suffolk

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ABSTRACT

The identity of a lungwort with cordate, unspotted leaves growing in Suffolk is confirmed as *Pulmonaria obscura* Dumort. Its recorded history in Suffolk is summarised. This plant grows on poorly drained, fertile soil in ancient woodland with a history of management by coppicing. The associated community according to the National Vegetation Classification is *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland. *P. obscura* is probably native in Suffolk: only a small extension of its recognised natural range will include the Suffolk population; it grows in a relatively natural habitat; the associated plant community in Suffolk is of a type which on the Continent frequently includes this species; it is very rarely grown in gardens and thus is unlikely to be a garden escape; and it reproduces sexually. This plant is known from just three adjacent woods where it covers a total area of 18 m^2. Formerly it was more abundant and its decline seems to be related to a decline and cessation of coppicing in its habitat. It is recommended that its population is increased by the resumption of coppicing.

KEYWORDS: Suffolk Lungwort, native status, Britain, Belgium.

INTRODUCTION

In 1842 a lungwort with unspotted, cordate leaves was discovered in Burgate Wood, E. Suffolk (v.c. 25). Soon after its discovery it was recognised as a taxon similar to, but distinct from *Pulmonaria officinalis* L. s.str. which is the exotic species commonly grown in gardens and occasionally naturalised, and was considered to be a probable British native. Nevertheless, there has been reluctance to acknowledge this lungwort as native. This paper aims to establish that the Suffolk Lungwort is *Pulmonaria obscura* Dumort. and a probable British native. *P. obscura* is rare and without native status it is unlikely to receive the protection it requires.

IDENTIFICATION

The Suffolk Lungwort can be characterised as follows.

Perennial herb with creeping rhizomes bearing simple, flowering or non-flowering shoots (Fig. 1). Flowering stem 10–33 cm long, with 4–7 ovate or elliptic leaves up to 7 cm long and 3 cm wide. Radical leaves mid-green and unspotted (or rarely with faint, light green spots); lamina ovate with cordate base, 9–21 cm long, 5–13·5 cm wide; petiole 10–21 cm long, 0·8–1·5 times as long as the blade. Upper leaf surface covered with numerous aculeoli and occasional bristles of various size. Autumn leaves do not over-winter and are usually similar in shape to the summer leaves. Calyx barrel-shaped, 9–11 mm long (mean ± 95% confidence limits = 9·6 ± 0·3 mm, n = 31) at flowering time, growing to 15 mm at fruiting time. Corolla 12–15 mm long (mean ± 95% confidence limits = 13·7 ± 0·5 mm, n = 31), at first dark pink (R.H.S. colour chart 58c to 59b), later dull violet (90b to 90d). Inside of corolla with hair ring but otherwise hairless. 2n = 14 (see Fig. 2).

These characteristics are consistent with *Pulmonaria obscura* Dumort. (1865) and the further

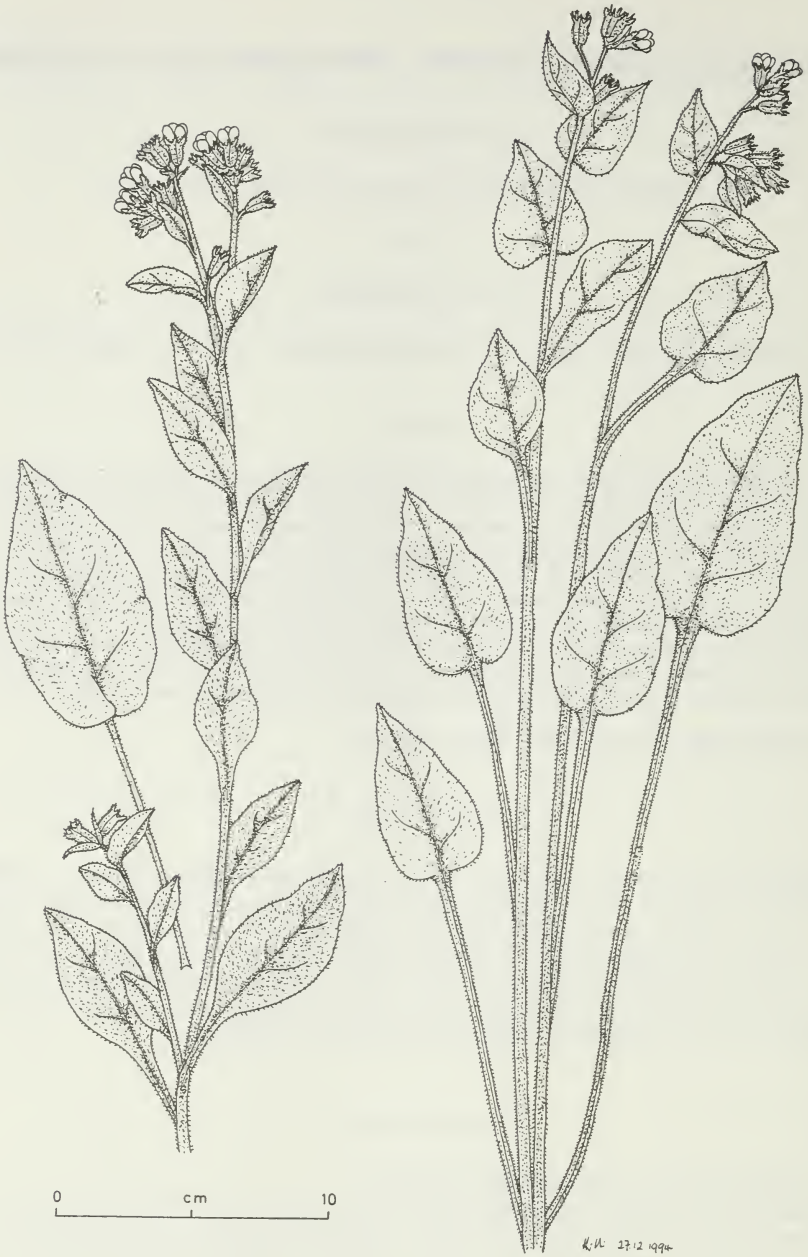

FIGURE 1. *Pulmonaria obscura* from Burgate Wood. Drawn from a herbarium specimen collected by W. M. Hind in 1885.

descriptions of this taxon given in Dumortier (1868), Wolkinger (1966), Sauer (1972) and Bollinger (1978). A herbarium specimen of the lungwort from Burgate Wood was examined by Prof. W. Sauer who confirmed it was *P. obscura* (pers. comm. 1993).

P. obscura is similar to *P. officinalis*, differing in its unspotted leaves, lack of over-wintering leaves, and chromosome number (for *P. officinalis* L. s.str., 2n = 16 (Bolliger 1978)). Formerly *P.*

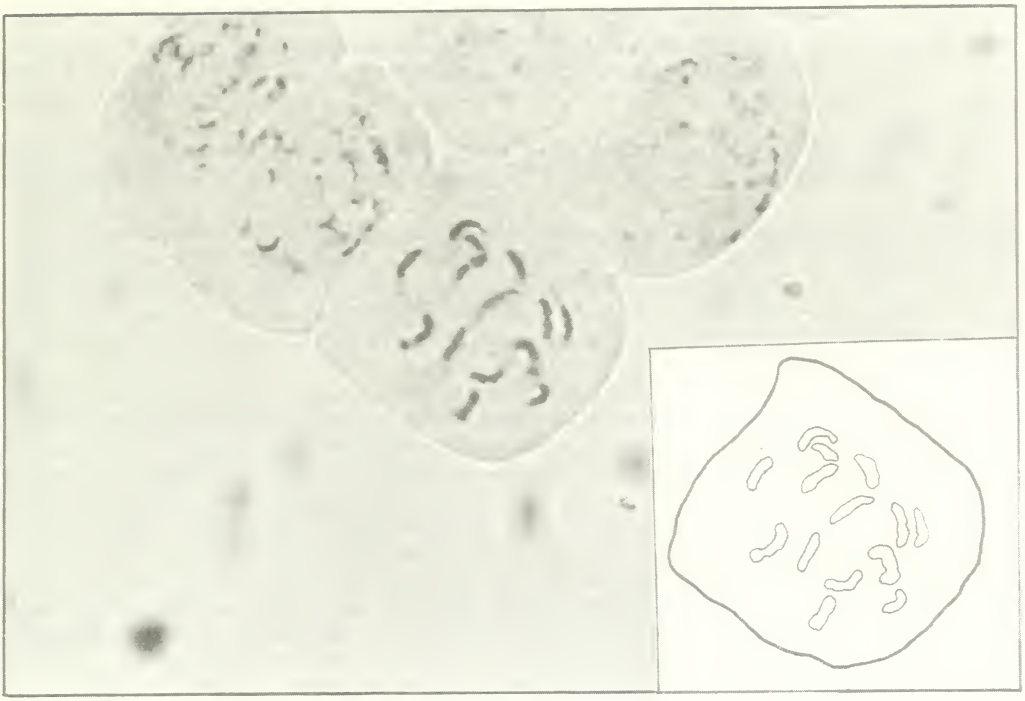

FIGURE 2. Mitosis in root tip cells of *Pulmonaria obscura* from Burgate Wood showing 2n = 14. The inset shows a tracing of the chromosomes. (Feulgen squash in 1N hydrochloric acid.)

obscura has been considered a variety or subspecies of *P. officinalis* (*P. officinalis* var. *immaculata* Opiz; *P. officinalis* subsp. *obscura* (Dumort.) Murb.). However, now, on the basis of the sterility of hybrids between the two taxa, its specific status is generally accepted (Merxmüller & Sauer 1972).

RECORDED HISTORY

A population of lungwort has been known at Burgate Wood in E. Suffolk (v.c. 25) since 1842 when it was found by C. J. Ashfield. Ashfield lived in Norfolk but later moved to Preston, Lancashire; his herbarium (including a specimen of lungwort collected at Burgate in April 1842) was donated to the Preston Scientific Society and is now in Liverpool Museum (**LIV**). Ashfield (1862) noted, when he published the record for the first time, "I think there can be no doubt about it being a genuine wild locality; for the plant is plentiful, it grows far into the interior of an extensive wood, and has much the appearance of being truly wild as any of the plants near it. It is now more luxuriant than usual, in consequence of the underwood having been recently cut, a fact which I noticed last September when I was in the wood."

W. M. Hind (1889) visited the site in 1885 (specimen collected 3 June 1885; **IPS**) and noted "the plant . . . in profusion; and, in less quantity, in Stubbing's Grove [Botesdale], about a mile [2 km] to the West. The plant differs from the cultivated form, in having leaves unspotted, or very faintly so. This may account for its having been passed over by the simplers, and left to enjoy its native shade." Page (1911) repeated Hind's observations and added that "*Pulmonaria officinalis* is left to stand alone as the county's unique production. It is considered by its discoverer, Mr. C. J. Ashfield, the Rev. E. S. Marshall and others to be a true native of Suffolk."

Marshall visited Burgate Wood on 8 May 1888 and collected specimens (**BM**, **CGE**). A specimen (**BM**) collected by Marshall, labelled "*Pulmonaria officinalis* L. (forma concolor) = v. *immaculata* Op.", was collected from a garden plant at Milford, where Marshall lived, in 1894 having been

grown from a root gathered at Burgate Wood in 1889. A note from Marshall states: "This differs from the garden form in having its leaves unspotted, a character maintained hitherto in cultivation and from seed. Its wildness in E. Suffolk appears to me (as to the late Dr. Hind) to be as little doubtful as that of *P. angustifolia* in Hants." There are also two specimens from the Milford garden plants in **NMW**.

W. C. Barton collected material at Burgate on 18 April 1913 which was widely distributed by the Watson Botanical Exchange Club (**BM**, **CGE**, **LCR**, **NMW**). Bennett (1913) identified this material as *P. obscura*.

Other herbarium specimens include: Burgate Wood, 3 June 1884 (herb. J. D. Gray: **CGE**); —, 24 April 1915 (herb. S. H. Bickham: **CGE**); —, 12 May 1922, *T. J. Foggitt* (**BM**); —, April 1923 (herb. J. E. Little: **CGE**); —, 16 June 1931, *E. Vachell* (**NMW**); —, 5 May 1934, *E. C. Wallace* (herb. J. E. Lousley: **NMW**); —, 5 May 1935, *J. F. G. Chapple* (**OXF**); Stubbing's Wood, 25 April 1937, *R. B. Ullman* (**BM**); —, 23 April 1938, *E. C. Wallace* (herb. P. M. Hall: **BM**); —, 24 April 1938 (herb. J. E. Lousley: **NMW**).

F. W. Simpson has known these populations for over 60 years, and commented (1982) that "in the 1930s the Common Lungwort was still quite abundant in both Burgate Wood and Stubbing's Grove. When the sites were visited in the 1950s, it could only be found in limited quantity in one area of Burgate Wood. In 1976, a search of both sites revealed a small colony in Burgate Wood and a single plant in Stubbing's grove." He also discovered a colony (recorded as *P. angustifolia* L. (Simpson 1950)) in West Suffolk (v.c. 26) at Millfield Wood, Polstead, some 32 km from Burgate, in May 1949. Much of this ancient wood was destroyed in the 1970s when electricity pylons were erected. No specimens were collected from this site, but photographs taken on 14 May 1950 show plants identical to those from Burgate Wood growing with *Galium odoratum*. Simpson (1982) also referred to a specimen with unspotted leaves in herb. J. Atkins (now at **IPS**), incorrectly identified as *P. angustifolia*, which had been collected in 1910 from Layham, 2 km west of Polstead; this specimen has not been located.

Rackham (1979) surveyed the lungwort population in Burgate Wood and located five separate colonies of total area 7·9 m^2 with 86 inflorescences. Rackham considered the lungwort to be native, noting that it occupied a precise ecological niche within the wood and was not associated with other introduced species.

In 1985, C. D. Pigott (pers. comm. 1987) saw the lungwort in Burgate Wood and confirmed that it was *P. obscura*, a species which he had seen in Poland. He thought it was probably native to Suffolk because of the rarity of this taxon in cultivation and its "continental" type of distribution in Europe (see below).

In 1993, one of us (M.S.) searched other woods in the vicinity of Burgate Wood and Stubbing's Wood, Botedale, for lungwort populations and discovered a population in Gittin Wood, Wortham, about 1 km north of Burgate Wood.

A search of herbaria at **BM**, **CGE**, **IPS**, **LIV**, **LCR**, **NMW** and **OXF** revealed no specimens of *P. obscura* from sites other than Burgate Wood and Stubbing's Wood.

HABITAT

Burgate Wood, Stubbing's Wood and Gittin Wood are all ancient woods located on chalky till, with a history of management as coppice with standards. Within these woods lungwort is confined to areas with poorly drained, fertile, mull soils of acid to neutral pH (Rackham 1979). The physical structure and pH of soil samples (0–10 cm deep) collected from the base of three lungwort plants in Burgate Wood is shown in Table 1. The associated vegetation at all three sites can be classified as the N.V.C. community *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland (subcommunity *Anemone nemorosa* or *Primula vulgaris-Glechoma hederacea*) (Rodwell 1991) or according to the Peterken classification, ash-maple woodland (stand subtypes 2Aa or 2Ba) (Peterken 1981) (see Table 2). Other plants frequently associated with lungwort include *Ajuga reptans*, *Arum maculatum*, *Carex sylvatica*, *Circaea lutetiana*, *Corylus avellana*, *Geum urbanum*, *Glechoma hederacea*, *Lamiastrum galeobdolon*, *Listera ovata*, *Orchis mascula*, *Poa trivialis*, *Rubus fruticosus*, *Urtica dioica* and *Viola reichenbachiana* (see Table 2).

The lungwort occurs in deep shade below a full canopy, semi-shade in gaps, and almost full light in

TABLE 1. PHYSICAL COMPOSITION (% DRY WEIGHT) AND pH OF THE SOIL (CORE 0–10 CM DEEP) ASSOCIATED WITH THREE *PULMONARIA OBSCURA* CLUMPS IN BURGATE WOOD

	Sample		
	1	2	3
Physical composition			
stones (>1 cm diam.)	0·0	0·0	1·7
$CaCO_3$ (>1 cm)	0·0	0·0	0·0
stones (2 mm–1 cm)	0·3	0·0	0·5
$CaCO_3$ (2 mm–1 cm)	0·0	0·0	0·0
coarse sand	34·3	43·4	37·8
fine sand	42·1	29·1	33·4
silt	2·5	11·3	11·6
clay	16·0	12·2	9·0
$CaCO_3$ (<2 mm)*	0·3	0·5	1·1
organic matter**	4·5	3·5	5·0
pH***	4·2	7·0	4·1

* using a Rothamsted Calcimeter; ** by combustion at 350°C; *** in slurry with water using a Gallenkamp pH meter.
Rackham (1979) lists the soil pH at three lungwort clumps as: 7·4, 6·7, 4·6.

woodland rides. However, it flowers more freely, produces larger leaves, and grows more vigorously in conditions of higher illumination (Ashfield 1862; Rackham 1979). In Burgate Wood, lungwort is confined to the most recently coppiced parts of the wood (i.e. coppiced in 1964 and 1972) (Rackham 1979). Research is required into the dormancy and germination requirements of *P. obscura* seed, in particular, to test the hypothesis that dormant seed are stimulated to germinate by coppicing.

CASE FOR PRESUMING NATIVE STATUS

Webb (1985) provided criteria for assessing whether plants are native or alien to the British Isles, as follows:

1. "A species is more likely to be native if it was first recorded at an early date than if it was first recorded at a later date." While *P. obscura* was first recorded in Britain in 1842, this cannot be regarded as strong evidence against this species being native because it is rare and easily overlooked.

2. "A species is more likely to be native in the British Isles if it is recognised as a native in neighbouring countries than if it is not." *P. obscura* has a continental distribution (sensu Matthews 1955). Its distribution as an accepted native is shown in Fig. 3 (adapted from Bolliger 1978). The continental population nearest to that in Suffolk is in the Ardennes, a direct distance of c. 400 km. East Anglia has the most continental climate in Britain (Watt 1938) and several other species with a continental distribution gain a toehold here (e.g. *Artemisia campestris*, *Thymus serpyllum*, *Scleranthus perennis* subsp. *prostratus*, *Silene otites*, *Veronica spicata* subsp. *spicata*). In France and Belgium, *P. obscura* is also restricted to areas with the most continental climate.

3. "A species is more likely to be native if it grows extensively in natural habitats than if it is restricted to man made habitats." All populations of *P. obscura* are in ancient woods (as listed in English Nature's Ancient Woodland Inventory). Moreover, the community *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland, associated with *P. obscura*, is regarded as a calcareous variant of the *Carpinion betuli* (Rodwell 1991), a community which on the continent includes *P. obscura* (Oberdorfer 1970; Bolliger 1978; Ellenberg 1988). In a population of *P. obscura* near Virton, Belgium, visited in 1994, grew many species also associated with *P. obscura* in Suffolk (see Table 2).

4. "A species which is commonly cultivated is more likely to become naturalised than one which is rarely cultivated." Several species of lungwort have striking foliage or flowers and have been occasionally or frequently cultivated either as decorative plants or for their medicinal properties which are associated with their patterned leaves (which supposedly resemble diseased lungs)

TABLE 2. WOODLAND MANAGEMENT AND PLANT COMMUNITIES ASSOCIATED WITH ONE BELGIAN AND THREE SUFFOLK POPULATIONS OF *PULMONARIA OBSCURA*

Location	Bois de Grandcourt Virton, Belgium		Burgate Wood Suffolk, U.K.		Stubbing's Wood Suffolk, U.K.		Gittin Wood Suffolk, U.K.	
Woodland management	Coppice with standards		Recently coppiced with standards after years of neglect		None; formerly coppice with standards		None; formerly coppice with standards	
N.V.C. Community	W12a		W8a		W8b**		W8b	
Species	Domin	Constancy	Domin	Constancy	Domin	Constancy	Domin	Constancy
Trees/shrubs:								
*Acer campestre**	0–1	I	1–8	V	0–7	–	7	–
Acer platanoides	0–1	I	0	0	0	–	0	–
Acer pseudoplatanus	4	I	0	0	0	–	0	–
Betula pubescens	0	0	4	I	0	–	0	–
Carpinus betulus	0	0	0–1	II	0	–	0	–
*Corylus avellana**	2–9	V	5–8	V	2–9	–	7	–
Crataegus laevigata	0–5	IV	0	0	0–5	–	4	–
Crataegus monogyna	0	0	1–2	V	0	–	0	–
Daphne mezereum	0–1	I	0	0	0	–	0	–
Euonymus europaeus	0	0	0–2	IV	0	–	2	–
Fagus sylvatica	5–8	V	0	0	0	–	0	–
Fraxinus excelsior	0–7	I	5–7	V	0–9	–	8	–
Malus sylvestris	0	0	0	0	0	–	1	–
Populus tremula	0	0	4	I	0	–	0	–
*Quercus robur**	0–6	III	0–5	V	1	–	4	–
Ribes uva-crispa	0–2	II	0	0	0	–	0	–
Rosa sp.	0–1	II	0	0	0	–	0	–
Sambucus nigra	0	0	0–2	II	0	–	0	–
Salix caprea	0	0	0–6	I	0	–	0	–
Viburnum lantana	0–1	II	0	0	0	–	0	–
Viburnum opulus	0	0	1	I	0	–	0	–
Herbs:								
Agrostis stolonifera	0	0	0	0	7	–	0	0
*Ajuga reptans**	0–2	II	0–1	I	0–1	–	0–4	IV
Allium ursinum	0	0	0	0	0	–	0–1	I
*Anemone nemorosa**	1–4	V	0	0	0–1	–	2–8	V
*Arctium minus**	0–1	I	0	0	0–1	–	0	0
*Arum maculatum**	0–2	V	0–1	II	0–1	–	0–2	III
*Brachypodium sylvaticum**	0–2	I	0–1	I	0	–	0	0
Calamagrostis epigejos	0	0	0	0	0–2	–	0	0
Carex hirta	0	0	0	0	0–1	–	0	0
*Carex sylvatica**	0–5	V	0–1	III	1–2	–	0–1	II
Circaea lutetiana	0	0	0–2	II	0–2	–	0–2	III
Cirsium arvense	0	0	0	0	0–2	–	0	0
Cirsium palustre	0	0	0	0	0–1	–	0	0
Clematis vitalba	0–1	I	0	0	0	–	0	–
Dactylis glomerata	0	0	0	0	0–2	–	0	0
Dactylorhiza fuchsii	0	0	0	0	0	–	0–1	I
*Deschampsia cespitosa**	0–1	I	1	I	0–3	–	0	0
Dryopteris filix-mas	0	0	0	0	0	–	0	0
Epilobium obscurum	0	0	0	0	0–1	–	0	0
Euphorbia amygdaloides	0–4	II	0	0	0	–	0	0
Filipendula ulmaria	0	0	0–1	II	0	–	0	0
*Fragaria vesca**	0–1	I	0	0	0–1	–	0–5	III
*Galium aparine**	0–2	I	0	0	0–2	–	0–2	III
Galium odoratum	0–2	III	0	0	0	–	0	0

TABLE 2. *continued*

Species	Domin	Constancy	Domin	Constancy	Domin	Constancy	Domin	Constancy
Geranium robertianum	0–3	IV	0	0	0	–	0	0
*Geum urbanum**	0–1	II	0–2	III	0–1	–	0–2	III
Glechoma hederacea	0	0	0–4	IV	0–1	–	0–4	III
*Hedera helix**	2–5	V	0	0	0	–	0–1	I
Holcus lanatus	0	0	0	0	0	–	0–1	I
Hyacinthoides non-scripta	0	0	0	0	0	–	0–5	III
*Hypericum hirsutum**	0–1	I	0	0	0–1	–	0	0
Hypericum tetrapterum	0	0	0	0	0–1	–	0	0
Juncus effusus	0	0	0	0	0–1	–	0	0
*Lamiastrum galeobdolon**	0–4	IV	0–4	III	0	–	0–4	III
Lamium album	0–1	I	0	0	0	–	0	0
Listera ovata	0	0	0–1	II	0	–	0–1	I
Lonicera periclymenum	0	0	0–2	III	0–2	–	2	0
Luzula pilosa	0	0	0	0	0	–	0–1	I
Lychnis flos-cuculi	0	0	0	0	0–1	–	0	0
Melica uniflora	0–2	I	0	0	0	–	0	0
*Mercurialis perennis**	0–3	IV	1–9	V	0–2	–	0	0
*Orchis mascula**	0–2	I	0–1	I	0	–	0–1	I
Paris quadrifolia	0	0	1	I	0	–	0–1	II
*Poa trivialis**	0–1	I	0–7	IV	7	–	0–4	V
*Potentilla sterilis**	0–1	I	0–1	II	0–2	–	0–2	III
Primula elatior	0–1	V	0	0	0	–	0	0
Primula vulgaris	0	0	0–1	I	0–1	–	0–1	I
Prunella vulgaris	0	0	0	0	0–1	–	0	0
Ranunculus auricomus	0–1	I	0	0	0	–	0	0
*Ranunculus ficaria**	0–2	III	0	0	0	–	0–2	III
*Ranunculus repens**	0–2	I	0	0	0	–	0	0
Rubus caesius	0	0	0	0	0	–	0–1	I
Rubus fruticosus agg.*	0–4	IV	0–1	II	0–2	–	0–8	IV
Rumex sanguineus	0	0	0	0	0–2	–	0–1	II
Sanicula europaea	0	0	0	0	0	–	0–2	IV
*Stachys sylvatica**	0–1	I	0	0	0–1	–	0–1	I
Stellaria media	0	0	0–1	II	0–1	–	0	0
Taraxacum officinale agg.*	0–1	I	0	0	0	–	0–1	I
*Urtica dioica**	0–4	I	0–1	II	0–1	–	0–4	I
*Veronica chamaedrys**	0–1	I	0–2	II	0–1	–	0–1	I
*Vicia sepium**	0–2	II	0	0	0	–	0–1	I
*Viola reichenbachiana**	0–1	II	0–2	III	0–1	–	0–3	III
Bryophytes:								
Atrichum undulatum							X	
*Brachythecium rutabulum**	X		X				X	
Calliergon cuspidatum			X					
*Eurhynchium praelongum**	X		X		X		X	
*Fissidens taxifolius**	X		X				X	
*Plagiomnium undulatum**	X		X				X	
Rhynchostegium confertum	X							
*Thamnobryum alopecurum**	X		X				X	
Thuidium tamariscinum			X					

Nomenclature follows Stace (1991) for vascular plants and Watson (1981) for bryophytes.

For explanation of "Domin" and "Constancy" values see Rodwell (1991). N.V.C. Communities (Rodwell 1991):

W8a – *Fraxinus excelsior-Acer campestre-Mercurialis perennis* Woodland, sub-community *Primula vulgaris-Glechoma hederacea*

W8b – *Fraxinus excelsior-Acer campestre-Mercurialis perennis* Woodland, sub-community *Anemone nemorosa*

W12a – *Fagus sylvatica-Mercurialis perennis* Woodland, sub-community *Mercurialis perennis*

* Species associated with *P. obscura* in both Belgium and Suffolk.

** the lungwort in Stubbing's Wood occurs on recently created woodland rides, a transitional community which is difficult to classify; the adjacent woodland is W8b.

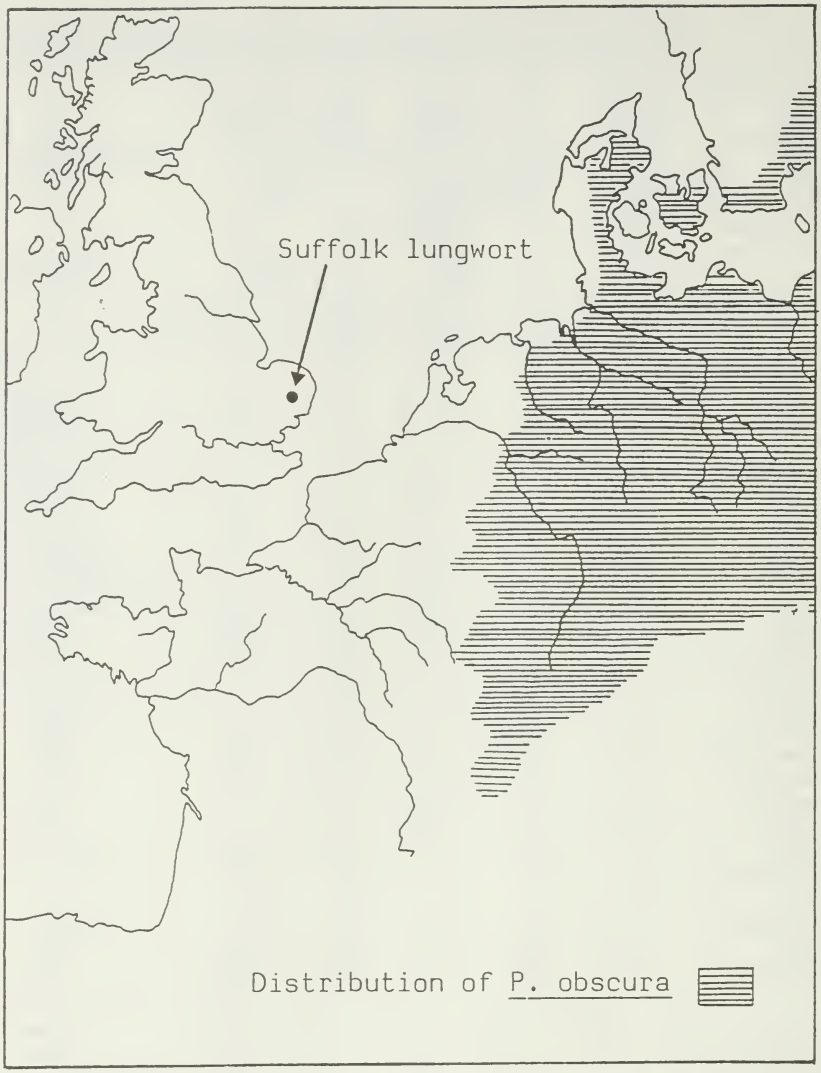

FIGURE 3. Distribution of *Pulmonaria obscura* as an accepted native in North West Europe (adapted from Bolliger 1978).

(Grieve 1980). On occasion these species have become naturalised. However, *P. obscura* lacks patterned foliage, its flowers are dull, and it seems to have been rarely cultivated (although, on occasion, plants collected from Burgate Wood have been grown by botanists). Several taxa of lungwort are included in early British books on horticulture (e.g. Parkinson 1629; Gerard 1633; Miller 1768), but none of these can be identified definitely as *P. obscura*. Parkinson (1629) listed three lungworts: *Pulmonaria maculosa*, *Pulmonaria altera non maculosa* and *Pulmonaria angustifolia*. According to the descriptions, *Pulmonaria maculosa* is synonymous with *P. officinalis*, and *Pulmonaria angustifolia* with *P. longifolia* (Bast.) Boreau, but *Pulmonaria altera non maculosa* could refer to any of several lungwort species with unspotted leaves. Gerard (1633) listed and illustrated three lungwort taxa (note that in Johnson's edition of this work the illustrations are disordered (Wilmott 1917)). These are synonymous with *P. officinalis*, *P. saccharata* Miller and, on the basis of their elliptical, unspotted leaves and blue flowers, *P. angustifolia*. Miller (1768) listed six

TABLE 3. CHARACTERISTICS OF THE SUFFOLK LUNGWORT (*PULMONARIA OBSCURA*) POPULATION, APRIL 1994

Location	No. clumps	Total area (m^2)	No. flowering stems	No. clumps with seedlings	Morphs
Burgate Wood	12	7	20	4	pin+thrum
Stubbing's Wood	4	5	77	2	pin+thrum
Gittin Wood	11	6	c. 470	5	pin+thrum
Totals	27	18	c. 567	11	

lungwort taxa none of which is referable to *P. obscura*, but Miller & Martyn (1807) included "*Pulmonaria non maculosa folio* L. *Sp. Pl.* p. 135 (1753)" which is synonymous with *P. obscura*. However, this publication is a dictionary for gardeners and botanists and includes many taxa which were not cultivated. Present-day horticultural accounts of the genus *Pulmonaria* exclude *P. obscura* (e.g. Stuart 1990; Bloom 1994; Griffiths 1994) or, when mentioned, state that it is not cultivated (e.g. Mathew 1982). *P. obscura* appeared in *The plant finder* for the first time in 1992 (Philip 1992). Monksilver Nursery, Cambridgeshire, which stocked this material, had obtained it from a wild, foreign population.

Although Burgate Wood contains earthworks showing that part of the wood was settled, the lungworts do not grow in this area (Rackham 1979). No other garden escapes are associated with the lungwort except for *Ribes rubrum* L., a species dispersed widely by birds.

P. obscura is heterostylous with pin and thrum morphs. It is unusual to find both morphs in garden populations because typically it is introduced to the garden as a division from a single monomorphic clump. Therefore, further evidence against a garden origin for the Suffolk plants is the presence of both morphs in all three populations.

5. "A species is more likely to be native if it reproduces by seed rather than solely by vegetative means." In April 1985, Pigott (pers. comm.) recorded seedlings around adult plants in Burgate Wood and, in April 1994, seedlings were recorded around adult plants in all three woods.

CURRENT POPULATION AND CONSERVATION

In April 1994, the three known *P. obscura* populations were surveyed to estimate the number of clumps in each (clumps were defined as groups of plants separated by more than 1 m from other groups), the area they occupied, the number of flowering stems, the number of clumps with associated seedlings, and the presence of pin and thrum morphs. The results are presented in Table 3. All the lungwort colonies reported by Rackham (1979) in Burgate Wood are extant and had a similar total area to that reported by him. All the known plants in Stubbing's Wood grow on two recently created, wide, periodically mown, woodland rides, a habitat which will probably prove unsuitable for this species in the long term.

Although no quantitative data are available, the comments of Ashfield (1862) and Simpson (1982) suggest that during the last century and at the start of this century, *P. obscura* was more abundant in Burgate Wood and Stubbing's Wood than at present. Its decline is probably related to the decline and cessation of coppicing during the twentieth century. Currently, Stubbing's Wood and Gittin Wood are not coppiced, but recently, coppicing of Burgate Wood has recommenced. It is recommended that the effect of coppicing on the lungwort population of Burgate Wood is monitored and if favourable, this management should be applied to the other sites.

Burgate Wood, Stubbing's Wood and Gittin Wood are within 1 km of each other. Burgate Wood is a site of special scientific interest but the other two sites have no legal protection although they are on the register of county wildlife sites. *P. obscura* is to be included in the third edition of the *British red data book* for vascular plants (Wigginton, in prep.).

There is no public access to Burgate Wood, Stubbing's Wood or Gittin Wood and permission to enter must be obtained from the owners before any visit. Plants of *P. obscura* originating from Burgate Wood can be seen in Cambridge University Botanic Garden.

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The conservation status of *Lythrum hyssopifolia* L. in the British Isles

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ABSTRACT

Seven geographically distinct populations of *Lythrum hyssopifolia* L. (Lythraceae) currently exist in the British Isles, with the total population in mainland Britain recently numbering in the region of 600,000–700,000 individuals. Over 90% of this total occurs around a single lake in Gloucestershire. This site has only recently been colonized, and it seems the seed originated either from migratory waterfowl (Anatidae) from continental Europe or from corn fed to wintering birds. The distribution of the species does not seem to have altered significantly in the British Isles during the present century. At present, the conservation status of six of the populations seems favourable, although measures are proposed at three of these in order to improve the situation. The only population in immediate danger is in Oxfordshire, where habitat management to halt succession is urgently required if flowering plants are to continue to survive.

KEYWORDS: Exposed-mud, Lythraceae, habitat management, migratory birds, dispersal, winter flooding, protected areas.

INTRODUCTION

Grass-poly, *Lythrum hyssopifolia* L. (Lythraceae), is a characteristic component of the "exposed-mud" flora, and occurs on the northern limit of its European range in Britain (Webb 1968; Fitter 1978). The exposed-mud environment is created by winter flooding that subsides in the spring to reveal exposed-mud for the summer period, and is subsequently reflooded in the autumn. Typically, exposed-mud species germinate after the water-levels fall in the spring and complete their life-cycle by the autumn. The majority are therophytes, whilst others, potentially perennial and invariably hemicryptophytes, usually adopt the therophytic strategy when growing in this environment. The species exhibit, in varying degrees, significant specialization for the colonization of exposed-mud, and because they are adapted to such an ephemeral environment, they are intolerant of long-term competition (Salisbury 1968, 1970).

The exposed-mud habitat was once a common element of the British countryside but it has disappeared rapidly this century, mainly as a result of land drainage/fill operations, and lack of appropriate management resulting in succession (Salisbury 1970; Palmer & Newbold 1983). At present, ten native vascular plant species characteristic of this habitat are nationally rare, while a further five are scarce (see Table 1). Thus, the exposed-mud flora is clearly of special conservation concern. *L. hyssopifolia* is one of the rarest of these species and until recently was thought to be confined to just two sites in the British Isles, located in Cambridgeshire and Jersey (Preston & Whitehouse 1986). Owing to its rarity it is listed in the *British red data book* (Perring & Farrell 1983), and since 1988 it has been listed in Schedule 8 of *The wildlife & countryside act, 1981*, making it a criminal offence intentionally to pick, uproot or destroy plants of this species (HMSO 1981, 1988).

The aims of this paper are to: (i) review the current status of *L. hyssopifolia* in the British Isles, (ii) describe any action that has been taken to conserve current populations, and (iii) provide recommendations for future action.

Nomenclature of vascular plants follows Kent (1992) and abbreviations of herbaria follows Kent & Allen (1984).

TABLE 1. NATIONALLY RARE AND SCARCE NATIVE VASCULAR PLANT SPECIES CHARACTERISTIC OF THE EXPOSED-MUD FLORA IN THE BRITISH ISLES (AFTER SALISBURY 1970; STACE 1991; STEWART *ET AL.* 1994)

Rare species (≤ 15 10-km squares)	Scarce species (16–100 10-km squares)
Corrigiola litoralis	*Cicendia filiformis*
Cyperus fuscus	*Elatine hexandra*
Damasonium alisma	*Elatine hydropiper*
Eleocharis parvula	*Illecebrum verticillatum*
Juncus pygmaeus	*Limosella aquatica*
Limosella australis	
Lythrum hyssopifolia	
Pulicaria vulgaris	
Ranunculus ophioglossifolius	
Rorippa islandica	

METHODS

Botanists and conservationists local to all of the current *L. hyssopifolia* sites in the British Isles were contacted and questioned regarding the current status and conservation of the species, and site visits were made to three areas during 1993; in Cambridgeshire (five sub-populations), Gloucestershire (three sub-populations) and Oxfordshire. Censuses were conducted by counting individual plants, but if this was not feasible owing to the abundance of the species (i.e. at one sub-population in Gloucestershire and one in Cambridgeshire), figures were estimated by measuring the area occupied by a population, counting the number of individual plants in a sample of ten random quadrats (0·25 m^2) and multiplying the total count from these quadrats to correspond with the total area occupied by the species.

RESULTS

In 1993, *Lythrum hyssopifolia* was known to occur within seven 10-km squares in the British Isles[1], all of which were located in the south. The following account provides details of the status and conservation of the species within each of these areas, from west to east (see Fig. 1):

Area A (GR WV/6.5, v.c. S, Jersey). 0–10 m a.s.l. The species was rediscovered at Grouville Marsh (Jersey) in 1993 (F. Le Sueur in litt. 1995), following the records of 1839 and 1894 (Le Sueur 1984). The plant was found growing on muddy, open ground, that was created following the clearance of an area of *Salix* scrub. By the following year (1994), other marsh vegetation had colonized the area and *L. hyssopifolia* was excluded. However, during the same year it was found in another area of the marsh where there was more recent clearance of *Salix* scrub. Plants have not been counted at the marsh, but there was certainly in excess of 100 individuals in both 1993 and 1994. The area of the marsh where the plant has been recorded is owned and managed by the National Trust for Jersey (F. Le Sueur in litt. 1995).

Area B (GR WV/7.5, v.c. S, Jersey). 10–20 m a.s.l. In St Catherine's Bay (Jersey), the species is established on disturbed and seasonally flooded ground within an area that was previously quarried for granite. It was first recorded here in 1841 by W. W. Newbould, before quarrying activity began in 1847. At present, "a reasonable" population occurs here, although numbers fluctuate greatly from year to year. The area receives some conservation protection, but re-landscaping and succession are potential threats to parts of the population (Le Sueur 1984; F. Le Sueur in litt. 1993, 1995).

Area C (GR SO/7.0, v.c. 34, W. Gloucs.). 5 m a.s.l. Three sub-populations are established at The

[1] In 1989, *L. hyssopifolia* was recorded from a site close to Rosslare Harbour in Co. Wexford (v.c. H12) where it was probably alien (R. FitzGerald, pers. comm. 1995).

FIGURE 1. Current 10-km square distribution of *Lythrum hyssopifolia* in the British Isles (see text for details of each site, A–G).

Wildfowl & Wetlands Trust (W.W.T.) Slimbridge Reserve, Gloucestershire. It was first recorded here in 1985 by B. Stewart, on winter flooded areas around "Swan Lake" (Figs 2 & 3). By 1988, c. 30,000 plants were present (C. D. Preston in litt. 1993), expanding rapidly to an apparently stable population of c. 600,000 in 1993. Since 1989, a sub-population has become established around a nearby winter flooded depression, known as the "Long Ground Scrape", where numbers are apparently stable, with 10 to 70 individuals recorded annually (D. B. Paynter in litt. 1993; this study). Since 1991, another sub-population has become established within a 5 ha expanse of winter flooded ground that forms part of an area known as the "South Lake". Until 1991, this area was permanent pasture utilized for sheep grazing, but was subsequently developed primarily for wintering waterbirds, involving winter flooding. *L. hyssopifolia* quickly colonized the area and the sub-population currently totals c. 10,000 individuals. All three areas are included within a nature reserve that is leased and managed for conservation purposes by W.W.T. The plant has also been recorded from five other areas within the reserve (D. B. Paynter in litt. 1993; this study), but its occurrence at these is very sporadic and plants have not been present at any of them in recent years.

Area D. (GR SY/9.9, v.c. 9, Dorset). 60 m a.s.l. In Dorset, the species is established on the headland of an arable field adjoining a wet copse. A nearby spring keeps the ground more-or-less permanently damp, although the area is much wetter in winter, when tractor activity causes substantial disturbance. The plant was first recorded here in 1984 by B. Edwards, and numbers steadily increased to about 50 plants in 1989. However, in 1990 and 1991 the field was turned over to grass ley and an autumn sowing regime was established. Owing to the cessation of disturbance, *L. hyssopifolia* did not germinate during this period. Since 1992, however, arable crops have again been farmed and the *L. hyssopifolia* population has increased from less than 500 individuals to just under 2,000 in 1994. The site is privately owned and an informal management agreement has been established (D. Pearman in litt. 1995).

Area E (GR SU/6.8, v.c. 22, Berks.). 45 m a.s.l. The species is established on a small area of winter flooded ground between an arable field and a small pond near Cholsey, Oxford (formerly Berkshire), adjacent to the River Thames. It was first recorded here in 1986[2] by J. Souster when four individuals were found. Since then, 20 individuals were recorded in 1987 (J. Souster & S. Everett in litt. 1987), and 13 in 1993. The area was formerly heavily disturbed during the winter, mainly by farm machinery, but this has since ceased following a recent change in land ownership. Consequently, the site is becoming over-grown, including *Salix caprea* saplings up to 2 m high, and it is evident that *L. hyssopifolia* is being out-competed by more long-term perennial species (J. Souster in litt. 1993; this study). Flood-control measures on the River Thames may also have contributed to these unfavourable conditions (J. Souster in litt. 1995). The site has no conservation protection, and there are no formal conservation management agreements established.

Area F (GR SU/7.0, v.c. 13, W. Sussex). 3 m a.s.l. The species is established on a small area of winter flooded ground in the corner of the arable field on Thorney Island, West Sussex. It was first recorded here in 1987 by D. J. P. Miller, with a stable population of c. 250 plants between 1987 and 1992, but only 33 plants in 1993. The site is ploughed annually, and both the tenant farmer and the landowner (The Ministry of Defence) have entered a voluntary conservation management agreement with English Nature, the implementation and success of which is being monitored by a local conservation group (M. Briggs in litt. 1993; Briggs 1988, 1990; H. Matcham in litt. 1993).

Area G (GR TL/4.4, v.c. 29, Cambs.). 20–30 m a.s.l. The species is established in winter-flooded depressions (periglacial hollows) within fields around the villages of Fowlmere, Little Shelford, Whittlesford, Newton and Thriplow (Cambridgeshire) (Preston & Whitehouse 1986). It was first recorded from this area in 1958 by Mrs G. Crompton (Coombe *et al.* 1959 a, b), with subsequent surveys locating 36 sub-populations in 17 fields (Preston & Whitehouse 1986; Preston 1995). Sixteen of these fields are farmed for cereal production, while the other is used as horse pasture. Between years, the total population varies from c. 10,000 to c. 50,000 individuals. The vast majority of the population is confined to about five sub-populations, with most others supporting only a few individuals once every few years (A. Arbon in litt. 1995; this study). In 1993, the total population numbered c. 15,000 individuals. Five fields containing the most important sub-populations were designated the Whittlesford-Thriplow Hummocky Fields Site of Special Scientific Interest (S.S.S.I.)

[2] Herbarium material in **OXF**, **RNG**, **CGE**, E and **BM** collected from "Cholsey" in 1835 could have originated from this site.

FIGURE 2. Prime winter conditions for *Lythrum hyssopifolia* around Swan Lake, Gloucestershire (January 1994).

FIGURE 3. *Lythrum hyssopifolia* growing at the centre of the area depicted in Figure 2 (August 1994).

by English Nature in 1987 (Preston 1989), thus providing these sites with special legal protection and a formal conservation management agreement.

DISCUSSION

STATUS AND DISTRIBUTION

The current geographical distribution of *L. hyssopifolia* is comparable to that earlier this century, being confined to the southern lowlands of the British Isles (cf. Preston & Whitehouse 1986). The size of the total population within Great Britain has never been estimated, and this is still not possible due to a lack of census data from Jersey. However, data from this study suggest that the total population in mainland Great Britain has been in the region of 600,000–700,000 individuals in recent years, with over 90% of this total around Swan Lake in Gloucestershire. This estimate should be treated with caution, however, as exposed-mud species can be conspicuously variable in their abundance between years (Salisbury 1970). This is clearly apparent with regard to *L. hyssopifolia* in Cambridgeshire, where the species' abundance is largely dependent on the rainfall of the previous autumn/winter (Preston & Whitehouse 1986; Coombe 1990). Similar variations in abundance are apparent in Jersey (F. Le Sueur in litt. 1993, 1995). However, following the initial colonization process at Swan Lake and the Long Ground Scrape in Gloucestershire, numbers between years seem to have become relatively stable. Presumably, this is due to the relatively consistent degree of disturbance and winter flooding between years: these factors are much more variable in Cambridgeshire (Preston & Whitehouse 1986; Preston 1989; Coombe 1990), and presumably also in St Catherine's Bay (Jersey). The sub-population at South Lake in Gloucestershire has increased following recent colonization, whilst the small populations in Sussex and Oxfordshire seem to have been relatively stable, although a decline is predicted in Oxfordshire due to the cessation of winter disturbance.

ORIGIN OF THE GLOUCESTERSHIRE POPULATION

Considering the significant contribution of the Gloucestershire *L. hyssopifolia* population to the national status of this species it seems pertinent to discuss its possible origin. Prior to the discovery of the Swan Lake population in 1985, the plant was previously unrecorded from Gloucestershire, the closest record being of an alien occurrence "in the Bristol area" in 1932 (Riddelsdell et al. 1948), at least 30 km to the south of Swan Lake. Seed was probably transported to Swan Lake in the early 1980s either by its adhesion to migratory waterfowl or its ingestion and subsequent excretion by the birds (cf. Salisbury 1970), or by corn fed to wintering waterfowl. At the time of the discovery of the plant around Swan Lake (1985), the only other known localities supporting the species in the British Isles were in Cambridgeshire, Dorset and Jersey (St Catherine's Bay), while in continental Europe it is widespread south of c. 52°N (Fitter 1978; Webb 1968). Many migratory waterfowl from continental Europe visit Swan Lake during the winter, the principal species being Bewick's Swan (*Cygnus colombianus bewickii*) (c. 200 individuals), Mallard (*Anas platyrhynchos*) (c. 250 individuals), Pintail (*Anas acuta*) (c. 60 individuals), Pochard (*Aythya ferina*) (c. 1,300 individuals) and Tufted Duck (*Aythya fuligula*) (c. 600 individuals) (D. B. Paynter, pers. comm. 1994). Of these, the most likely vectors of *L. hyssopifolia* seeds would be Mallard, Pochard and Tufted Duck, since many of these birds migrate to Great Britain from the continental range of *L. hyssopifolia* (cf. Webb 1968; Fitter 1978; Owen *et al.* 1986).

Considering *L. hyssopifolia* frequently occurs in cornfields, it is also possible that seed was transported to Swan Lake with the corn fed to wintering waterfowl. Most of this corn originates from the West Midlands of England, from where the only records of *L. hyssopifolia* pre-date 1950 (Preston & Whitehouse 1986). However, on (very few) occasions "sweepings" of split corn have been collected from Sharpness Docks (Gloucestershire), where seed is exported and imported from a diversity of sources. Although *L. hyssopifolia* has never been recorded from the docks, it remains possible that this is the source of the seeds. Unfortunately, it seems impossible to prove conclusively whether commercial grain or migratory waterfowl are responsible for the establishment of *L. hyssopifolia* in Gloucestershire.

CONSERVATION REQUIREMENTS

The most important factor governing the persistence of *Lythrum hyssopifolia* at a site is the

continuation of regular winter disturbance. Under natural conditions, this is provided by fluctuating water-levels, but under more artificial conditions it can be complemented by disturbance from ploughing, livestock or machinery. Considering this, the future of the species seems favourable in Gloucestershire, Sussex, the main sites in Cambridgeshire and at St Catherine's Bay (Jersey). If *Salix* clearance is continued on a rotational basis at Grouville Marsh (Jersey), then the species survival here would also seem favourable. In St Catherine's Bay, there is no immediate threat to the species, but more stringent protection measures are necessary to remove the potential threat of re-landscaping, and habitat management may be necessary if succession becomes a problem. The very small population at Cholsey (Oxfordshire) is especially threatened by succession, and it seems the species can no longer survive there without the presence of mechanical disturbance during the winter. At a site located within a horse pasture near Newton (Cambridgeshire), the best area for the species has been fenced off. Ironically, this has caused a decline in numbers, since more long-term perennial species are beginning to dominate the area following the cessation of disturbance from the activity of horses. This area needs to be re-opened to grazing and a sympathetic stocking regime developed.

Formal management plans have been produced and are being implemented for the benefit of the species in Sussex and at the main sites in Cambridgeshire, while more informal plans are being implemented in Dorset, Gloucestershire and Jersey. As yet, however, there are no such agreements concerning the Oxfordshire population, which clearly needs remedy.

All sites supporting the species in Gloucestershire, the main sites in Cambridgeshire and at Grouville Marsh (Jersey), have been afforded formal conservation protection, while the site at St Catherines Bay (Jersey) is partially protected. Of the three unprotected sites (in Dorset, Sussex and Oxfordshire), probably only the Oxfordshire site could immediately benefit from such protection.

The following measures are proposed to sustain the current status of the species in the British Isles:

Area A, Grouville Marsh (Jersey).
  i. Rotational *Salix* clearance on an annual basis.
Area B, St Catherine's Bay (Jersey).
  i. Better site protection.
  ii. Habitat management may be necessary if succession becomes a problem.
Area C, Wildfowl & Wetlands Trust Slimbridge Reserve (Gloucestershire).
  i. No additional measures are currently required.
Area D, Poole (Dorset).
  i. No additional measures are currently required.
Area E, Cholsey (Oxfordshire).
  i. Re-establishment of mechanical disturbance during winter.
  ii. Production and implementation of management agreement.
  iii. Evaluation of the need for site protection following action (ii).
Area F, Thorney Island (Sussex).
  i. No additional measures are currently required.
Area G, Fields around Fowlmere, Whittlesford, Newton and Thriplow (Cambridgeshire).
  i. Re-assessment of management implemented at the horse pasture site near Newton.

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A survey of the distribution of *Fallopia* × *bohemica* (Chrtek & Chrtková) J. Bailey (Polygonaceae) in the British Isles

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ABSTRACT

A recording form including details of how to identify *Fallopia* × *bohemica* (Chrtek & Chrtková) J. Bailey (*F. japonica* × *F. sachalinensis*) was circulated to botanists. The results from this survey, and previously collected data from the University of Leicester, are presented here, with ploidy level and sex expression of the hybrids where known. The origins, distribution pattern, sex expression and possible consequences of the presence of the hybrids in the British Isles are discussed.

KEYWORDS: Japanese knotweeds, *Polygonum cuspidatum*, *Reynoutria japonica*, hybridisation.

INTRODUCTION

Fallopia japonica (Houtt.) Ronse Decraene var. *japonica* (*Reynoutria japonica* Houtt. var. *japonica*) (Polygonaceae) was introduced to Britain in the first half of the nineteenth century from Japan, most probably through the nursery garden of Philipp Franz von Siebold at Leiden. It appears that only the male-sterile clone was introduced, and consequently all seed produced by it is inevitably hybrid (Bailey 1994). *F. sachalinensis* (F. Schmidt ex Maxim.) Ronse Decraene, a native of southern Sakhalin and northern Japan, is assumed to have been introduced in 1869 (Conolly 1977). The hybrid between *F. japonica* and *F. sachalinensis* is called *Fallopia* × *bohemica* Chrtek & Chrtková) J. Bailey, and was first described in 1983 (*Reynoutria* × *bohemica* Chrtek & Chrtková) from the town of Náchod in northeastern Bohemia, Czech Republic. The identification was made solely on the basis of morphological characters. Bailey & Conolly (1985) suggested that six hexaploid (2n = 66) and three tetraploid (2n = 44) plants they had examined were probably hybrids between *F. japonica* and *F. sachalinensis*. Production of, and comparison with, a range of artificial hybrids produced at the University of Leicester strongly supported this identification (Bailey 1989). The interpretation of the two different ploidy levels in *F.* × *bohemica* is that the hexaploid hybrid is a cross between *F. japonica* var. *japonica* (2n = 88) and *F. sachalinensis* (2n = 44), whilst the tetraploid is a cross between *F. japonica* var. *compacta* (Hook. f.) J. Bailey (2n = 44) and *F. sachalinensis* (Bailey 1989).

By 1989 the number of wild hybrids known in the British Isles and studied cytologically had increased to 16 hexaploids and 4 tetraploids. Further, a significant number of the hexaploids were male-fertile and indeed, even today, the best and most convenient means of initial hybrid recognition is to spot male-fertile plants. During succeeding years additional records were

accumulated at the University of Leicester and from the B.S.B.I. county recorders; of particular note are the considerable number of records made by the Surrey Flora Committee. Unfortunately, despite access to artificial hybrids, we are still unable to distinguish unequivocally the 4x and 6x hybrids using any character other than chromosome number. It may be possible to use trichome characters, since the different proportions of *F. japonica* to *F. sachalinensis* genomes (2:1 in the hexaploid and 1:1 in the tetraploid) do appear to have an effect on the relative lengths and frequencies of the different lower epidermal trichomes. This possibility has not yet been fully explored. Another potential method is the use of various DNA "fingerprinting" techniques; work at the University of Leicester is currently evaluating this possibility. Here we are combining the results of our earlier cytological research (Bailey & Stace 1991) with records based solely on morphological identification. We have personally examined herbarium material for all the locations cited, except those reported by Miss V. Gordon and Dr Alan Leslie which we have taken on trust. This does mean that a number of locations are without chromosome data. Herbarium specimens for almost all the accessions in Table 2 are at **LTR**.

Although the hybrid can be readily distinguished from its parents, the key differences are not widely available. This, and the reluctance of some botanists to concern themselves with aliens, has led us to suspect that *F.* × *bohemica* may be an under-recorded element of the British and Irish flora. Even in the distribution maps produced by Conolly (1977), some *F. japonica* and *F. sachalinensis* records may have been *F.* × *bohemica*. Although no research has been done on the vegetative vigour of *F.* × *bohemica*, there is no reason to think it any less vigorous than *F. japonica* var. *japonica*, and its larger leaf size and stature may indicate that the hybrid has a higher productivity. *F. japonica* var. *japonica* itself has been examined as a potential biomass crop (Callaghan *et al.* 1984).

SURVEY METHODS

In order to obtain a better idea of the distribution and abundance of *F.* × *bohemica* in the British Isles an information sheet detailing the key points of recognition plus a standard recording form were produced and circulated to B.S.B.I. members in Autumn 1993. Additional, modified sheets were produced and circulated to members of the Arboricultural Advisory and Information Service (A.A.I.S.) and the Henry Doubleday Research Association (H.D.R.A.). This resulted in a total mailing of 4,700. The salient features of the information sheet are reproduced in Fig. 1 and Table 1.

In addition to the number of sites, we were also interested in the area occupied by the plant at each site, in order to give a very rough idea of its invasiveness. Requests for this information were included on the questionnaire, and additionally three well-known sites, two in Cirencester (E. Gloucs., v.c. 33) and one in Amroth (Pembs., v.c. 45), were visited and detailed measurements made of the extent of the hybrid plants.

This project featured at B.S.B.I. exhibition meetings in 1992 (Leicester & Loughborough Universities 1993), 1993 and 1994. The 1993 and 1994 exhibits were recorded by title only: *Japanese knotweed hybrid survey; results of the Leicester and Loughborough Universities joint research*, and *Unravelling the British distribution of Fallopia* × *bohemica*, respectively. This paper is a full account of the hybrid survey and covers material exhibited at all three meetings.

RESULTS

Over 300 replies were received, but not all respondents had correctly identified the hybrid. Some of the responses concerned previously compiled records not known to us but published in county Floras. The map (Fig. 2) shows the results of the survey, split into pre- and post-1993 records; those records identified as a direct result of our survey are shown as closed circles.

Table 2 gives details of all 126 localities that are separable by a six-figure grid reference. Most of these sites are on roadside verges, the remainder are along watercourses and in the grounds of large estates. There is no discernible difference between the habitats of *F.* × *bohemica* and its two parents. These records translate into 81 10-km records on the B.R.C. distribution map (Fig. 2), which shows fewer records than the table as many squares contain more than one site. This taxon was clearly an under-recorded element of the British and Irish flora, since 34 new sites have been

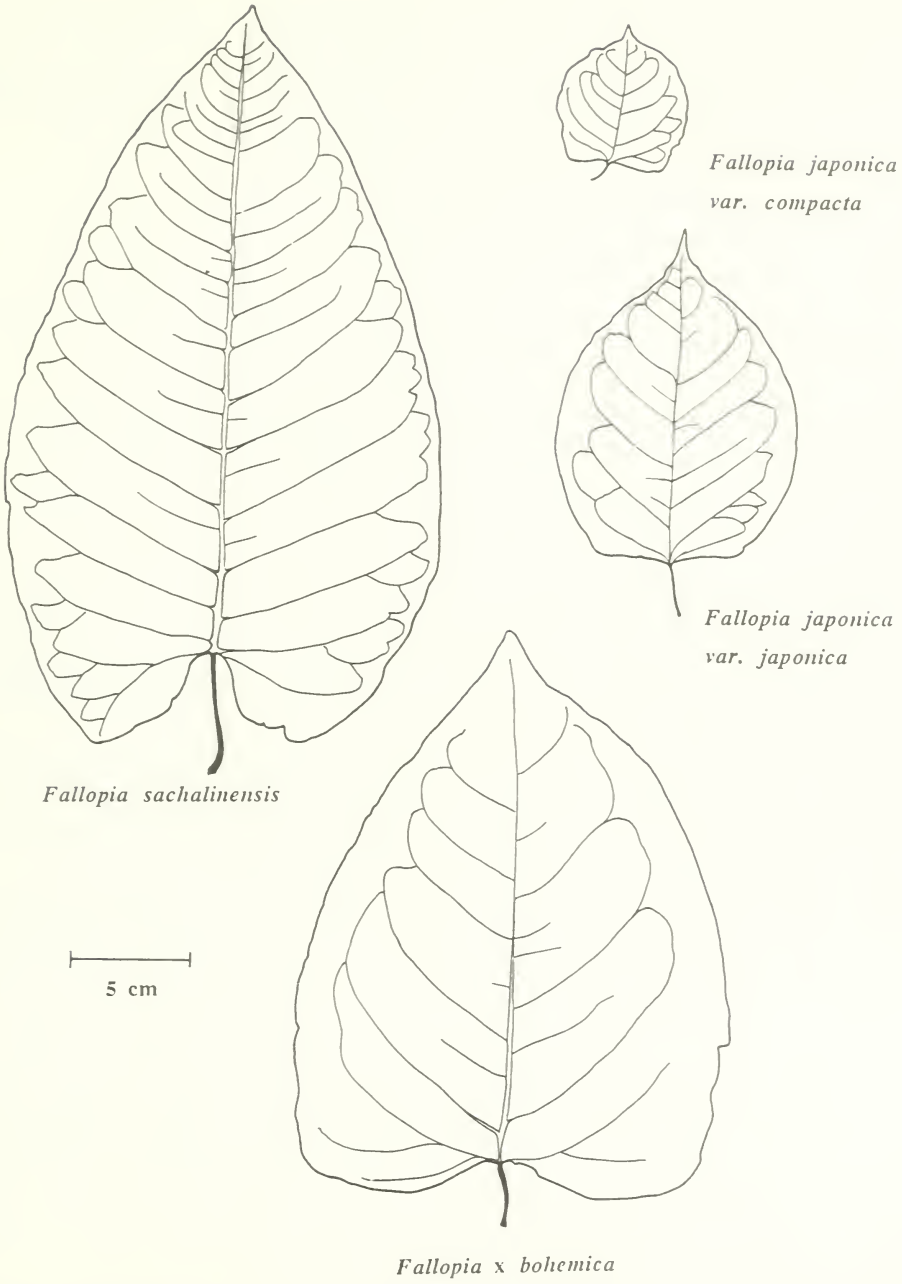

FIGURE 1. Leaves of *Fallopia japonica*, *F. sachalinensis* and *F.* × *bohemica* (after the illustration in the Japanese Knotweed Hybrid Survey leaflet).

TABLE 1. DISTINGUISHING CHARACTERS OF *FALLOPIA* × *BOHEMICA* (TAKEN FROM THE TABLE IN THE HYBRID SURVEY LEAFLET, SEE TEXT FOR DETAILS)

Character	*F. sachalinensis*	*F.* × *bohemica*	*F. japonica* var. *japonica*
Chromosome number	2n = 44	2n = 66 or 44	2n = 88
Height	Striking, gigantic plant to 4 m tall	Habit intermediate, 2·5–4 m tall	Large plant, 2–3 m tall
Leaf characteristics	Basal leaves ovate to oblong, base cordate	Leaves intermediate in size and shape, tip acuminate, weakly to moderately cordate at base	Leaves ovate, acuminate, base truncate
	Up to 40 cm long and 22 cm wide	Up to 23 cm long and 19 cm wide	10–15 cm long
	Length:width ratio c. 1·5	Length:width ratio 1·1–1·8	Length:width ratio 1–1·5
	Undersides of leaves with scattered, long, flexuous hairs (trichomes)	Undersides of larger leaves with numerous, short, stout hairs (trichomes) (easily visible with a hand lens)	Undersides of leaves glabrous
Sex expression	Male-fertile flowers (with exserted anthers) and male-sterile flowers (with small, empty, included anthers and well developed stigmas) borne on separate plants	Male-fertile and male-sterile flowers borne on separate plants	Flowers usually male-sterile

added as a result of the survey. Apart from Ireland, the distribution shows a generally western bias, with no records from Lincolnshire, East Anglia or Yorkshire. There is, however, an extraordinary concentration in Surrey (v.c. 17).

Data on sex-expression are available for 60 sites (46·8%) and on chromosome number for 35 locations (27·7%) (Table 3). Although the records in Table 3 do not represent a full data set, certain trends are apparent. Male-fertile plants outnumber male-sterile ones by nearly three to one, and hexaploid clones outnumber tetraploids by more than four to one. It is possible that this proportion of male-fertile to male-sterile plants is artificially high, since male fertility in itself is a convenient character for identifying hybrids and so may have biased the sampling.

Three selected *F.* × *bohemica* sites were examined in detail to assess both area of cover and the amount of genetic variation encountered (Tables 4 & 5). In Table 4, although the chromosomes of only three of the hexaploids were counted, they were clearly very different morphologically from the single tetraploid, yet very similar to each other. In these circumstances we consider it safe to assign all of them to hexaploid *F.* × *bohemica*. The five plants at Amroth were not in flower at the time of the visit, so an earlier record that the plants were male-fertile and hexaploid was used. On morphological grounds all five plants are thought to belong to the same clone. Though evidence from DNA studies would be required to confirm this, it is the usual pattern at *F.* × *bohemica* sites. In contrast, the Cirencester plants (Tables 4 & 5) exhibit an extraordinary range of variation, both in ploidy level and in sex-expression, with male-fertile and male-sterile hexaploids and male-sterile tetraploids. To our knowledge such an amount of variation in a relatively small area is unique to Cirencester.

DISCUSSION

This survey establishes that *F.* × *bohemica* represents a significant component of the Japanese knotweed population in Britain, in terms of both numbers of records and area covered. At

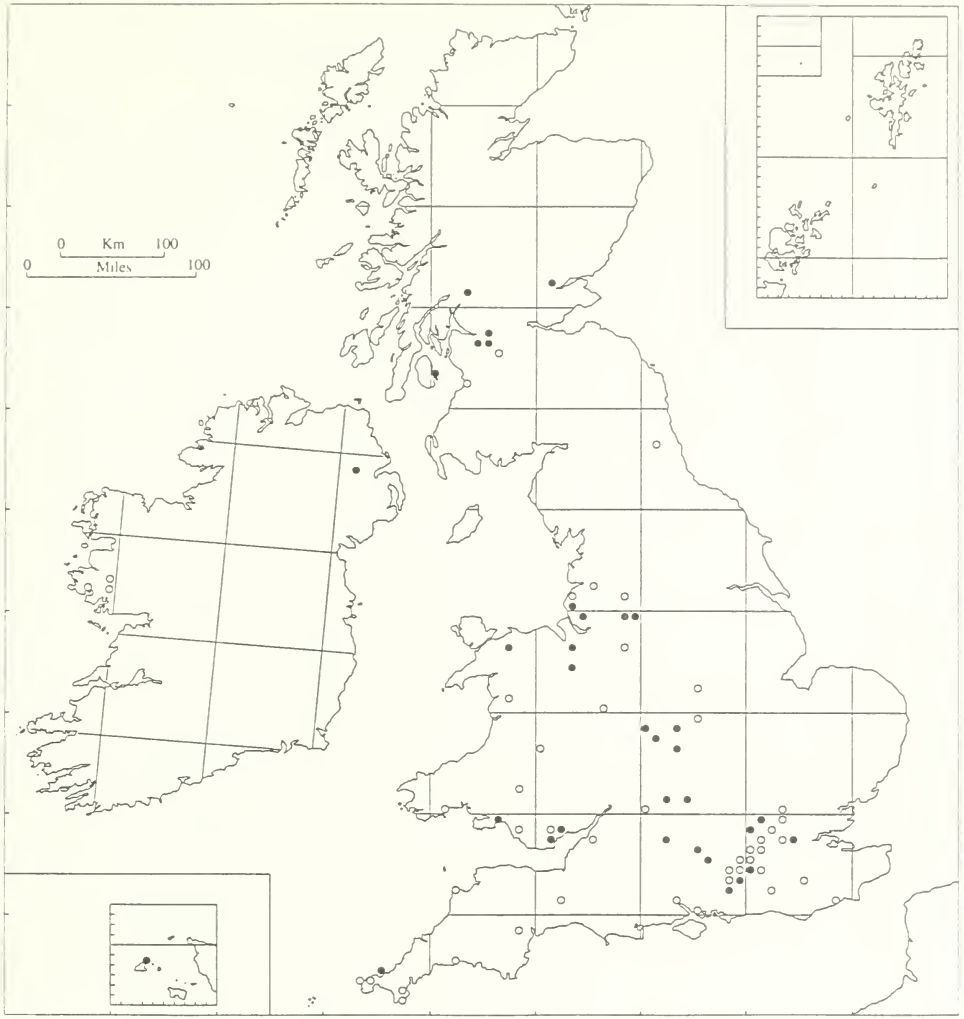

FIGURE 2. Distribution of *Fallopia* × *bohemica* in the British Isles. Open circles represent hybrids identified prior to 1993; closed circles those discovered 1993 onwards.

Cirencester Site A (Table 4), for example, a single stretch of roadside contained about 688 m^2 belonging to two different ploidy levels. Similarly, at Amroth a total length of 96 m of roadside was occupied by a single hexaploid clone. Cirencester is also distinguished in terms of the amount of genetic diversity of *F.* × *bohemica*. As male-fertile *F. sachalinensis* and the ubiquitous male-sterile *F. japonica* var. *japonica* also occur, it is possible to regard this area as something of a "hot spot" in terms of Japanese knotweed evolution, especially when the potential for back-crossing, made possible by such a concentration of genotypes, is considered.

In terms of the effectiveness of the survey, nobody sent in a record for any of the sites previously known to us. Further, the only duplication that we received in the new records was the extensive stand at Cannonhill Park, Edgbaston, of which we were notified by no fewer than three respondents. This was not a geographically based survey, and we were therefore dependent on individuals working their own particular locality; the four new records from the West Midlands, for instance, were the work of a single individual resident in the area. This fact, in combination with the

TABLE 2. LOCATION, SEX EXPRESSION AND CHROMOSOME NUMBER OF *FALLOPIA* × *BOHEMICA* PLANTS IN THE BRITISH ISLES

Locality	Vice-county	Grid reference	Sex expression	Chromosome number
England, Wales and Scotland:				
Towednack	v.c.1	SW/43.38		2n = 66
Lanarth	v.c.1	SW/770.210	male-fertile	
St Ives	v.c.1	SW/518.403		
St Just	v.c.1	SW/361.313		
Coverack	v.c.1	SW/781.185		
Porthallow	v.c.2	SX/226.516	male-fertile	2n = 66
Trenchford reservoir	v.c.3	SX/804.824		
Philham	v.c.4	SS/259.234		
Otterford Lakes	v.c.5	ST/224.138		
Freshford, Bradford on Avon	v.c.6	ST/784.600	male-fertile	
Rownham, Bristol	v.c.6	ST/56.72		
Belmont Hill, S.W. of Bristol	v.c.6	ST/517.704		
Aldbourne	v.c.7	SU/271.753		
Aldbourne	v.c.7	SU/262.756		
Aldbourne	v.c.7	SU/253.773		
Sarisbury	v.c.11	SU/500.079		
Southampton	v.c.11	SU/395.141		
Hartley Wespall	v.c.12	SU/696.575	male-fertile	
Basingstoke, A33	v.c.12	SU/677.569		
Ashfold	v.c.13	TQ/239.286		
Midhurst	v.c.13	SU/872.208	male-fertile	
Fernhurst	v.c.13	SU/880.267		
Lye Green	v.c.14	TQ/511.336	male-fertile	2n = c. 66
Coghurst Wood, Guestling	v.c.14	TQ/830.134	male-fertile	
Camberwell New Cemetery	v.c.16	TQ/354.744	male-fertile	2n = 66
ESE Charlton Railway station	v.c.16	TQ/419.782		
Gomshall station approach	v.c.17	TQ/087.478	male-sterile	2n = 44
Haslemere, roadside	v.c.17	SU/891.332		
Critchmere, Haslemere	v.c.17	SU/882.334		
Critchmere, Haslemere	v.c.17	SU/882.337	male-fertile	
Critchmere, Haslemere	v.c.17	SU/884.342	male-fertile	
Shottermill, Haslemere	v.c.17	SU/895.339	male-fertile	
Shottermill, Haslemere	v.c.17	SU/877.330	male-sterile	
Shottermill, Haslemere	v.c.17	SU/886.340	male-fertile	
Farnham	v.c.17	SU/856.454		
Witley, Barrow Hills	v.c.17	SU/940.398	male-fertile	
Witley, N. Culmer Hanger	v.c.17	SU/943.391		
Guildford, Shalford Common	v.c.17	SU/999.470	male-fertile	2n = 44
Guildford, Wey Navigation	v.c.17	SU/998.511		
Guildford, Stringers Common	v.c.17	SU/993.526		
Guildford, canal edge	v.c.17	SU/998.511		
Guildford, Sutton Green	v.c.17	TQ/000.541		
Guildford	v.c.17	TQ/003.509		
*Winterfold, Willinghurst	v.c.17	TQ/054.424	male-sterile	
Farley Green	v.c.17	TQ/058.454		2n = 66
New Haw, Wey Navigation	v.c.17	TQ/055.620		
*Pitch Hill, nr Ewhurst	v.c.17	TQ/081.428	male-sterile	2n = 44
Abinger, B2126	v.c.17	TQ/097.464		
Holmbury Hill car park	v.c.17	TQ/099.430	male-sterile	2n = 66
Albury Heath	v.c.17	TQ/061.465		2n = 66
Near Wonersh	v.c.17	TQ/034.446		
Wisley, R.H.S. Gardens	v.c.17	TQ/066.584	male-sterile	
Weybridge	v.c.17	TQ/067.641		
Holmbury Hill, footpath to Fort	v.c.17	TQ/105.427		2n = 66

TABLE 2. *continued*

Locality	Vice-county	Grid reference	Sex expression	Chromosome number
England, Wales and Scotland:				
*Cricket ground path, Holmbury St Mary	v.c.17	TQ/109.439		
Holmbury St Mary (3 stands)	v.c.17	TQ/112.444		
Esher, river bank	v.c.17	TQ/122.627		
Burhill Golfcourse	v.c.17	TQ/104.627		
West Molesey	v.c.17	TQ/132.668		
Ham riverlands	v.c.17	TQ/165.721	male-sterile	
Cheshunt	v.c.20	TL/368.028	male-sterile	2n = 44
Northwood, Jnct. A4125	v.c.20	TQ/100.929	male-fertile	
Tottenham Marshes	v.c.21	TL/352.909	male-sterile	2n = 44
Regents Park	v.c.21	TQ/286.826		
Woolhampton, nr Newbury	v.c.22	SU/566.682		
Shipton under Wychwood, A361	v.c.23	SP/273.176	male-fertile	
Blenheim Park, Woodstock	v.c.23	SP/43.15	male-fertile	
Black Park Country Park, Wexham	v.c.24	TQ/014.832		
Cirencester, Abbey Grounds	v.c.33	SP/025.023	male-sterile	2n = 66
Cirencester, Abbey Grounds	v.c.33	SP/025.023	male-fertile	2n = 66
Cirencester, Abbey Grounds	v.c.33	SP/025.023	male-sterile	2n = 44
Cirencester, A429	v.c.33	SP/039.033	male-sterile	2n = 44
Cirencester, A429	v.c.33	SP/039.033	male-sterile	2n = c. 66
Bristol, old dockside railway	v.c.34	ST/57.72	male-fertile	
Bristol, E. of Suspension Bridge.	v.c.34	ST/565.728	male-sterile	
Bristol	v.c.34	ST/531.777	male-sterile	2n = 66
Newport	v.c.35	ST/290.853	male-fertile	
Newport	v.c.35	ST/291.854	male-fertile	
Leamington Spa, Mid. War. College	v.c.38	SP/308.656	male-fertile	
Cannon Hill Park, Edgbaston	v.c.38	SP/066.841	male-fertile	
Corley, adj. B4098	v.c.38	SP/304.845		
Cheswick Green A34/M42 Junction	v.c.38	SP/145.757	male-fertile	
Ironbridge	v.c.40	SJ/67.03	male-sterile	2n = 66
Ogmore by Sea	v.c.41	SS/87.76	male-sterile	
Whitchurch, Velindre lodge	v.c.41	ST/144.802	male-fertile	2n = 66
Whitchurch, Golf club	v.c.41	ST/154.818		
Roath	v.c.41	ST/1.7	male-fertile	
Swansea, Blackpill; NE ornate bridge	v.c.41	SS/619.907	male-fertile	
Swansea, Blackpill; rear of carpark	v.c.41	SS/619.908	male-fertile	
Swansea, Blackpill; Derwen Fawr Rd	v.c.41	SS/617.908	male-fertile	
Llandrindod Wells	v.c.43	SO/058.612	male-fertile	2n = 66
Amroth	v.c.45	SN/167.071	male-fertile	2n = 66
Pont Rhyd-sarn, Llanuwchllyn	v.c.48	SH/859.287	male-fertile	2n = c. 66
Brithdir, Caerynwch Hall	v.c.48	SH/763.177	male-fertile	2n = 66
Dolgellau, Towyn Road	v.c.48	SH/711.183	male-sterile	2n = 66
Dolgellau, riverside	v.c.48	SH/723.180	male-fertile	
Llyn Crafnant, Trefriw	v.c.49	SH/753.626		
Dee embankment	v.c.51	SJ/360.664		
Clywedog Valley, Kings Mills	v.c.50	SJ/341.489	male-fertile	
Blaby, Leicester	v.c.55	SP/577.977		
Loughborough	v.c.55	SK/544.204	male-fertile	2n = 66
Dee embankment	v.c.58	SJ/390.660		
Small Wood End, nr Sandbach	v.c.58	SJ/806.602		2n = 66
River Goyt nr Stockport	v.c.58	SJ/917.907		
River Goyt nr Stockport	v.c.58	SJ/918.906		
Ainsdale	v.c.59	SD/307.119		
Victoria Park Southport	v.c.59	SD/326.166		
Southport	v.c.59	SD/332.178	male-fertile	2n = c. 66
Ince, Backwall Lane	v.c.59	SD/330.022		

TABLE 2. *continued*

Locality	Vice-county	Grid reference	Sex expression	Chromosome number
England, Wales and Scotland:				
Liverpool, railway nr Broad Green	v.c.59	SJ/407.905		
Heaton Mersey	v.c.59	SJ/866.901		
Preston, Riversway A583	v.c.60	SD/510.298	male-fertile	2n = c. 66
0·5 km E. of South Wylam railway station	v.c.66	NZ/124.646	male-fertile	2n = 44
Ayr	v.c.75	NS/33.21		2n = 66
Johnstone; Quarrelton	v.c.76	NS/414.625	male-fertile	
Nr Bothwell	v.c.77	NS/69.59		
N. Kelvinside, Glasgow	v.c.77	NS/568.680		
Dumbrock Loch	v.c.86	NS/547.782	male-fertile	
Nr Inverarnan Bridge	v.c.87	NN/319.186		
Scone Palace grounds	v.c.89	NO/118.263		
Brodick Country Park, I. of Arran	v.c.100	NS/014.376		
Channel Isles:				
Chateau des Marais, Guernsey	v.c.S	WV/333.803		
Ireland:				
East of Recess	v.c.H16	L/90.46		2n = 66
Maam	v.c.H16	L/963.533	male-sterile	2n = 66
Roundstone	v.c.H16	L/726.424		2n = 66
Lough Neagh, Antrim	v.c.H40	J/13.86		

* denotes putative backcross.

TABLE 3. BREAKDOWN OF *FALLOPIA* × *BOHEMICA* RECORDS BY SEX AND PLOIDY LEVEL
The sub-sample column records percentages of sex expression and ploidy level in the sub-sample for which these data are available; the final column expresses the same data but as a percentage of the whole sample.

Character	Number of records	Percentage of sub-sample	Percentage of total
Male-fertile	41	68·3	32·5
Male-sterile	19	31·7	15·1
2n = 44	8	22·9	6·4
2n = 66	27	77·1	21·4

very limited duplication of records experienced, suggests that a great many more hybrid localities await discovery. Where vice-county recorders happen to have an interest in the plant, as is the case in Surrey and South Lancashire, records appear to be much more numerous. In Surrey the local botanists have long been able to determine the hybrid, and had recorded it in the supplement to the county Flora (Leslie 1987). Is this abundance of records due solely to the expertise and enthusiasm of the local botanists? Does the Surrey distribution represent the sort of frequency that is waiting to be discovered in all regions, or is there something special about the history of the plants there? Without further data these questions are impossible to answer, though we do have evidence which suggests that a well-known garden designer, resident in Surrey, was recommending the planting of Japanese knotweeds and possibly had access to the hybrid.

The apparent scarcity of the hybrid in Ireland may be due to the lack of botanists looking for it there. We did not receive a single Irish response, but are informed (T. C. G. Rich, pers. comm. 1994) that the hybrid is common in parts of western Ireland.

Overall, the distribution of the hybrid (Fig. 2) bears a close resemblance to the pre-1920 distribution map for *F. japonica* var. *japonica* (Fig. 3). The significance of this, if any, is not clear. One suggestion is that the early records of establishment in some way reflect the preferred climatic conditions for the plant and that subsequent spread occurred later into sub-optimal regions; to this

TABLE 4. SEX EXPRESSION, CHROMOSOME NUMBER AND AREA OCCUPIED BY THE TWELVE STANDS OF *FALLOPIA* × *BOHEMICA* AT CIRENCESTER SITE A: ROADSIDE, A428 NEAR CIRENCESTER (V.C. 33; GR SP/039.033), 10 SEPTEMBER 1993

Code	Chromosome number	Sex expression	Area occupied (m^2)
A1	2n = 66	male-sterile	150
A2	hexaploid	male-sterile	30
A3	hexaploid	male-sterile	90
A4	hexaploid	male-sterile	24
A5	2n = 66	male-sterile	35
A6	hexaploid	male-sterile	21
A7	hexaploid	male-sterile	21
A8	hexaploid	male-sterile	114
A9	2n = 44	male-sterile	30
A10	hexaploid	male-sterile	72
A11	hexaploid	male-sterile	32
A12	2n = 66	male-sterile	69
Total area			688

TABLE 5. SEX EXPRESSION, CHROMOSOME NUMBER AND AREAS OCCUPIED BY THE ELEVEN STANDS OF *FALLOPIA* × *BOHEMICA* AT CIRENCESTER SITES C, D and E: CIRENCESTER ABBEY GROUNDS (V.C. 33; GR SP/025.023), 10 SEPTEMBER 1993

Code	Chromosome number	Sex expression	Area occupied (m^2)
C1	2n = 44	male-sterile	16·0
C2	2n = 66	male-fertile	0·5
C3	2n = 44	male-sterile	3·0
C4	2n = 44	male-sterile	1·5
C5	2n = 44	male-sterile	1·0
C6	hexaploid?	male-fertile	3·0
D1	2n = 66	male-fertile	60·0
D4	2n = 66	male-sterile	10·0
D5	2n = 66	male-fertile	40·0
D6			2·0
E1			100·0

day *F. japonica* var. *japonica* still has relatively few stations in East Anglia (Beerling *et al.* 1994). In the case of an introduced taxon one cannot ignore the stochastic element of where the plant happens to be first introduced. In Table 2 we have not distinguished between plants that were most probably planted and those which originated spontaneously or as throw-outs. Not only is this a virtual impossibility, since plantings for cover for game shooting (as is known to be the case with *F. sachalinensis* (D. McClintock, pers. comm.)) would be in open countryside, but, in any case, even were the plants to be in the gardens of large houses or public parks they could still act as important foci for secondary spread.

One can speculate that at early sites and at horticultural suppliers *F. japonica* was regarded as an asset, and that perhaps attempts to propagate it by seed were made. Owing to the absence of male-fertile clones of *F. japonica* var. *japonica* in this country, seed could have been produced by pollination with *F. sachalinensis* to give the hexaploid *F.* × *bohemica*. This is not to suggest that *F.* × *bohemica* can originate only through raising of seed by gardeners. There are documented cases of the spontaneous germination in situ of F_1 seed of *F.* × *bohemica* at Caerynwch Hall near Dolgellau, along with an array of hybrids that is suggestive of their having arisen unaided. However, the extreme rarity of locations where male-fertile *F. sachalinensis* grows within pollination distance of *F. japonica* var. *japonica* implies, perhaps, that this is not the main origin of *F.* × *bohemica* in the wild. At Cirencester, and possibly other locations, it is worth considering whether the hybrid is

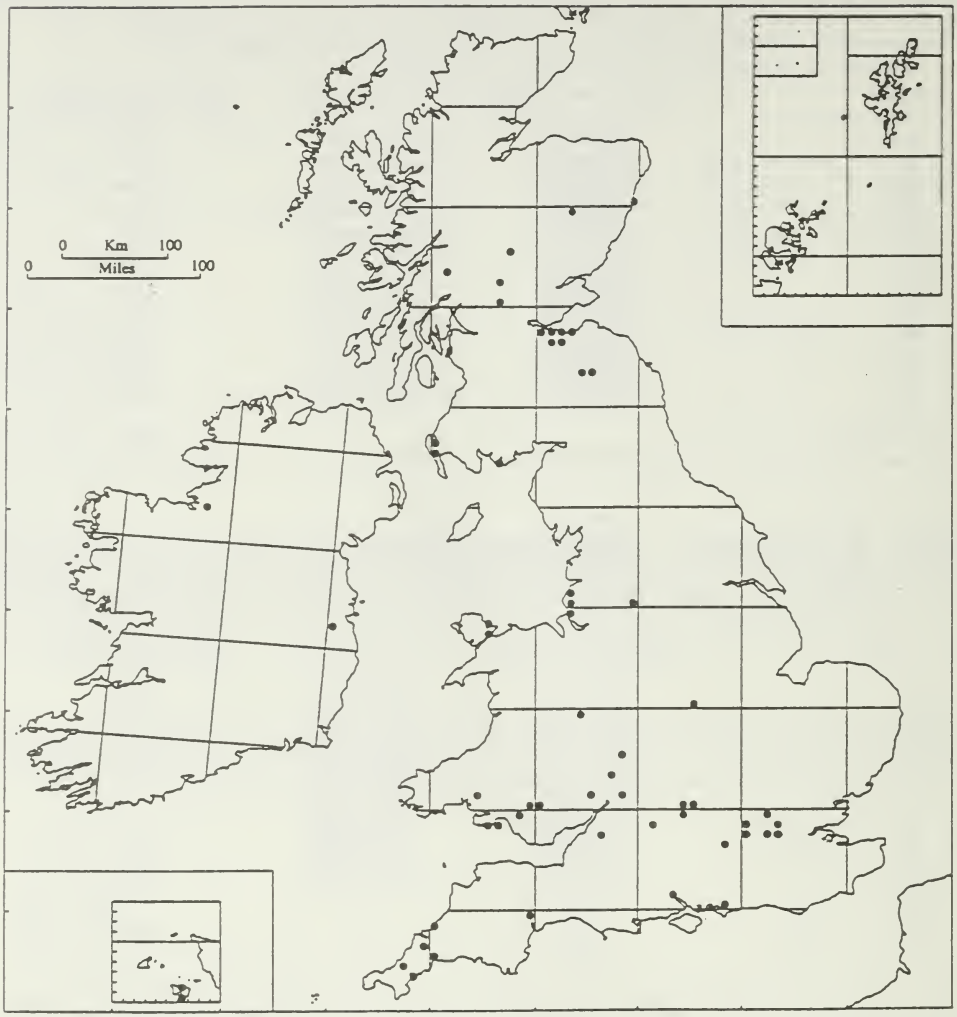

FIGURE 3. Records of *Fallopia japonica* up to 1920 (current B.R.C. records; see Conolly (1977) for additional records).

actually substituting for *F. japonica* var. *japonica*. There is more *F.* × *bohemica* present in Cirencester than of either parent. This does not imply any sort of ecological displacement, but it is possible that in some areas the first Japanese knotweed introduced was *F.* × *bohemica*.

In terms of the large excess of the hexaploid over the tetraploid hybrids, it is necessary to study the parentage of the tetraploid clones of *F. japonica* var. *compacta* × *F. sachalinensis*. In the wild, var. *compacta* is much less common than var. *japonica*, but in gardens there is a greater likelihood of finding the former, and as both sexes occur in each parent, there would appear to be even greater opportunities for hybridisation than is the case with hexaploid *F.* × *bohemica*. However, the earlier flowering time of var. *compacta* compared with *F. sachalinensis* could be a limiting factor.

One important consideration in the distribution and frequency of *F.* × *bohemica* is that, because it is frequently male-fertile, it is available as a potential pollen source for male-sterile octoploid *F. japonica*. Whilst the tetraploid hybrid has almost complete fertility, the hexaploid has irregular meiosis, low pollen viability and poor germination ability (Bailey & Stace 1991; Bailey 1994). The

hexaploid is not, however, completely sterile, and there is some evidence that it can occasionally form balanced tetraploid and diploid gametes. This raises the possibility of back-crossing with one of its parents, since, were tetraploid *F.* × *bohemica* pollen grains to fertilise *F. japonica* var. *japonica* flowers, this could result in male-fertile and male-sterile octoploid plants containing at least 75% *F. japonica* var. *japonica* chromosomes and capable of replacing, to all intents and purposes, the missing male-fertile *F. japonica* var. *japonica*. Examination of the chromosome number and lower epidermal trichomes of plants grown from open-pollinated seed from male-sterile tetraploid *F.* × *bohemica* plants at Cirencester, strongly suggests that some of them had been pollinated by *F. sachalinensis*. This indicates that back-crossing can occur and might explain the origin of some of the *F. sachalinensis*-like putative tetraploids found growing in Surrey (Pitch Hill; Winterfold; Holmbury St Mary, cricket ground path: asterisked in Table 2).

In contrast to *F. japonica* var. *japonica*, which is strongly suspected of being a single vegetatively produced clone, *F.* × *bohemica* appears to have a much broader gene-pool. There must be, at an absolute minimum, four different clones in the British Isles, since male-fertile and male-sterile individuals are found at both tetraploid and hexaploid ploidy levels. Modern molecular biological techniques are available that can confirm or confound such intuitive assessments, and preliminary PCR RAPD data (Bailey *et al.* 1995) from *F. japonica* var. *japonica* accessions support the single clone theory. The application of such techniques to *F.* × *bohemica* would allow identification of the different clones and enable us to track down their putative origins and to reconstruct the history of their spread.

Currently, very little of the seed produced by Japanese knotweeds in Britain appears to germinate spontaneously, though it is worth recalling the events in the University of Leicester in 1986. The extensive collection at Leicester has a much higher proportion of male-fertile taxa than is normally found in the wild, and so pollen availability is not a problem and large amounts of seed are formed in years without early autumn frosts. In April and May 1986, some, presumably fortuitous, combination of climatic factors led to an unprecedented germination rate. Japanese knotweed seedlings were sprouting between paving stones and in cracks in the gutters, giving every impression of being the aggressive coloniser that the species must be in its native habitats on volcanic lava fields in Japan. The lesson from this is that just because recruitment from seed is not currently an important factor in the spread of hybrids or back-crosses, it cannot be ruled out; the factors responsible for the 1986 events or a change in the climate might result in a new aggressive phase in the spread of Japanese knotweeds and their hybrids.

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Notes

RUBUS ASPERIDENS SUDRE EX BOUVET (ROSACEAE) IN THE BRITISH ISLES

Rubus asperidens, a widespread bramble of mainland Europe, features in the monograph of the genus by Watson (1958) as a British species, cited by him from five vice-counties, all but one in the far south-east of England. Subsequent examination of specimens so determined by him, however, has shown that he had an erroneous conception of this taxon and that his records were misattributed to it. Along with many other species claimed by him to occur in Britain, the name was relegated by Edees & Newton (1988) to an appendix listing names which have been applied to British Isles brambles dubiously at best.

Two pages earlier in the same work, Watson provided an account of another bramble well-known to earlier British batologists (as '*R. koehleri* var. *cognatus*') to which he had some years previously given the name *R. adenolobus* Watson. As that name later turned out to have been invalidly published, this species has since become familiar as *R. milesii*, a name chosen by Newton (1974) to commemorate the extensive work on the genus in Britain accomplished by the late B. A. Miles.

Watson listed the species he understood as *R. adenolobus* as occurring over a much wider part of Britain than has subsequently proved to be the case, betraying the fact that he interpreted the taxon rather loosely. In view of that, his claim to have seen material also from one département (Seine-et-Oise) in France has been disregarded, Edees & Newton (1988) having described the species as endemic to Britain. Since then Newton (1994) has also recorded this species from a wood in Co. Waterford, Ireland, v.c. H6. Newton has also recently informed the Belgian *Rubus* specialist H. Vannerom that a bramble collected in the Aachener Wald belonged to this species. The latter (in litt., 1993) regards the material in question as belonging to a rather variable species that embraces several taxa hitherto treated as distinct. That conclusion, however, is so sharply at variance with British experience of *R. milesii*, which is strikingly homogeneous throughout its range here, that it seems desirable that this broader interpretation be tested more widely before being generally adopted. In the present note, attention is accordingly given only to one of the several candidates proposed for that merger, as it has meanwhile emerged that this one at least is identical with *R. milesii* as presently understood by British batologists and bears a name, moreover, that has priority. Ironically, this is none other than *R. asperidens*, which Watson equated with one or more quite different brambles.

Already aware that Vannerom considered *R. asperidens* and *R. milesii* to be conspecific, I was nonetheless surprised to find a bramble in two woods in the Western Loire region of France in 1994 that was exactly the plant familiar to me under the latter name in Hampshire, in which it is common over much of the county. A. Newton subsequently concurred with my opinion that one of these French specimens was indistinguishable from the example in BM of *R. asperidens* distributed by Sudre as no. 556 in his *Batotheca Europaea*. It still remained to be established, however, that Sudre's interpretation of *R. asperidens* was the same as that of Bouvet, the original describer of the species.

Bouvet's name is absent from the *Index Herbariorum*, but his obituary mentions that he gave his collection to what was then known as the Herbier Lloyd (of which he acted for many years as honorary curator), now the Botanical Museum of the city of Angers. A loan from that institution, kindly arranged through the good offices of the Natural History Museum, provided me with sheets of five gatherings labelled in Bouvet's handwriting, all from localities cited for *R. asperidens* at the time of his description of the species (Bouvet 1907) and all patently identical with the British *R. milesii*. Four of the gatherings are labelled as *R. fuscus* Weihe, either with or without a question mark, and only one as *R. asperidens*, to which is attached a note about that species in Sudre's handwriting. It is this last specimen which must clearly be chosen as the lectotype, designated below.

There is some ambiguity about the rank intended by Bouvet for his new bramble. The name is printed in such a way as to suggest that it was to be treated as subordinate to *R. koehleri* Weihe &

Nees "(*sensu amplo*)". In the introduction to his paper Bouvet says that the arrangement follows that of Sudre's account of *Rubus* in Gandoger's *Novus Conspectus Florae Europae* (1905), but reference to that work fails to clarify matters. In a later paper Bouvet (1992) cites "*R. koehleri* subsp. *asperidens* Sudre in Bouvet" alongside a reference to his original description, but by then his usage is likely to have been influenced by Sudre's explicit preference in his own publications for giving it subspecific rank under *R. koehleri*. Fortunately, however, in a note appended to the protologue Bouvet used the words "cette espèce", which suggests that he did not have the formal rank of subspecies in mind at that time. It is also evident that this is a manuscript name of Sudre's that Bouvet was publishing on Sudre's behalf, so 'ex Bouvet' is technically the correct form of citation.

The synonymy is thus as follows:
R. asperidens Sudre ex Bouvet, *Bulletin de la Société d'Études scientifiques d'Angers* n.s. **36**: 58 (1907); *R. koehleri* var. *cognatus* sensu Rogers, *Journal of botany* **33**: 102 (1895); *Handbook of British Rubi* 83 (1900), non *R. cognatus* N. E. Brown in Sowerby, *English Botany*, ed. 3, Suppl. 101 (1892), pro parte; *R. fuscus* sensu Boulay in Rouy & Camus, *Flore de France* **6**: 94 (1900), pro parte, non Weihe in Bluff & Fingerhuth, *Compendium florae Germaniae* **1**: 682 (1825); *R. fuscus* sensu Bouvet, *Association française pour l'Avancement des Sciences faites en . . . Paris* 684 (1903); *R. koehleri* subsp. *asperidens* (Sudre ex Bouvet) Sudre, *Rubi Europae* **5**: 186 (1912); *Batotheca Europaea* fasc. 12, no. 556 (1914); *R. adenolobus* W. C. R. Watson, *London naturalist* **1934**: 61 (1935) (nomen non rite publ.); *R. milesii* A. Newton, *Watsonia* **10**: 25 (1974).
Lectotypus [here designated]: route des Landes à Saint-Lambert-de-la-Potherie, Saint-Jean-de-Linières, près d'Angers, Maine-et-Loire, France, 27 vii 1904, *G. Bouvet* (**ANG**).

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ARENARIA BALEARICA L. (MOSSY SANDWORT): OBSERVATIONS ON WATER-BORNE SPREAD IN PERTHSHIRE

Arenaria balearica L. (Caryophyllaceae) is an attractive, small, mat-forming perennial commonly grown in rock gardens. It is endemic to the Western Mediterranean and ascends to 1450 m (Chater & Halliday 1993). In the British Isles it is rarely naturalized any distance away from gardens so that its presence along several kilometres of a riverside habitat in Perthshire is of note.

I first noticed this species in the early 1950s on the River Almond in Perthshire where it formed conspicuous patches on the vertical walls of the bathing stage at Trinity College, Glenalmond. In 1967 while working in Perthshire I discovered further colonies both upstream and downstream from the school and was curious as to their origin. Further exploration showed the plant to be abundant

on the stonework of the riverside garden of Tulchan House some 3 km upstream from the school. This appeared to be the obvious source of the *Arenaria* on the Almond and, indeed, searching further upstream from Tulchan House failed to reveal any plants. Lt Col. B. A. Innes, the owner of Tulchan House at the time, told me that although parts of the house were 250 years old, the garden had been reconstructed in the period 1922–1924. It seemed likely that the introduction of *Arenaria balearica* may have dated from that time. Significantly, Francis Buchanan White (1898) did not record this species from Perthshire.

I also mentioned the plant to Alan Robson, the B.S.B.I. recorder for Mid-Perth (v.c. 88). He too had found *Arenaria balearica* on the Almond in 1967 and kindly gave me his own and additional records. Of interest was a record made a few years prior to 1950 by Miss Stewart of Methven from the south side of the Almond at Damdykes. She had been unable to refind it there in 1967. We had thought of writing an account of *Arenaria balearica* but nothing was done and sadly Alan Robson died in 1981.

In 1994 I managed to revisit some of the localities on the Almond and look at other sites. The species was still present at Tulchan House but very sparingly as the riverside banks were now much overgrown. There were, however, at least three large colonies covering several square metres downstream to Trinity College. These were on flat sandstone rocks at the edge of the river which would be covered by higher than average floods and on damp vertical cliffs ascending to 4·5 m above the mean river level. These cliff plants looked very much part of the native flora with *Crepis paludosa* (L.) Moench, *Cystopteris fragilis* (L.) Bernh., *Geranium robertianum* L., *Galium odoratum* (L.) Scop. and the thallose hepatic *Conocephalum conicum* (L.) Underw. as associates. Some colonies had been lost since 1967. The bathing stage at the school had gone, with no sign of masonry, and a colony reported by Alan Robson from the north side had been destroyed by a landslip caused by a fallen tree. Downstream from the school, a small colony was seen above Millhaugh Bridge and two large colonies covering several square metres on horizontal sandstone and vertical dolerite rocks some distance above and below Dalcrue. There was no sign of plants on tree stumps or bases previously seen and reported in 1967. The colony on the east-facing side of the Tay below the George Hotel at Perth reported by Murray (1964) was in a healthy state. It seems likely that it also is derived from Tulchan plants some 19 km distant. The Almond enters the Tay 4 km upstream on the same side and its current when in flood would flow against the high vertical retaining wall on which *Arenaria balearica* grows.

Colonization of these riverside habitats is probably from seed but vegetative spread is also possible. The fragile stems break easily and, when planted, root from the ends and nodes. These could be trapped on the mossy silt-covered substrates and produce colonies which become a source for further spread. This process must have been active on the Almond for some 70 years. Significantly, all except one of the recently seen colonies grew on the south side of the river. This northern aspect was favoured and prevents the plants from drying out. The single colony on the south facing side was on horizontal rocks on a steep side section of the river where the southern aspect was shaded by a steep tree covered slope. George Swan (1993) mentions several localities for *A. balearica* on the River Tyne (Northumberland) although most are too far from the river to be of possible waterborne origin. However one site on the North Tyne near Barrasford, discovered by Michael Braithwaite in 1971, was near the river's edge. This habitat was very similar to the Perthshire ones of mossy rocks on the south side of the river above the normal flood level but at the occasional flood level (M. Braithwaite pers. comm., 1995). There may be as yet undiscovered colonies upstream. *Arenaria balearica* is well established on the River Almond and its future seems secure. The rocky nature of the riverside habitat, which is regularly scoured by floods, ensures that this habitat remains open and free from competition and allows *Arenaria balearica* to survive. It would be interesting to know whether waterborne spread is a means of dispersal in its native Mediterranean localities.

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THE STATUS OF *SPIRANTHES ROMANZOFFIANA* CHAM. (ORCHIDACEAE), IRISH LADY'S TRESSES, ON COLONSAY (V.C. 102) IN 1995; WITH SPECIAL REFERENCE TO ASSOCIATED PLANT COMMUNITIES

Spiranthes romanzoffiana was unknown outside America until it was discovered in south-west Ireland in 1809 or 1810; it was recorded from the north of Ireland in 1892. A *Spiranthes* species was found in Coll, Scotland in 1921, but was not correctly identified as *Spiranthes romanzoffiana* until 1939. The first positive identification of the species for Britain was based on a water colour sketch and accompanying shrivelled specimen sent from the Scottish Hebridean Isle of Colonsay in 1930 (Loder 1935; Horsman 1989). In Europe, *Spiranthes romanzoffiana* is confined to the British Isles.

Perring & Farrell (1977, 1983) class *Spiranthes romanzoffiana* as a *British red data book* (B.R.D.B.) species. Stewart, Pearman & Preston (1994) class it as a "Scarce plant" with 18 post-1970 10-km squares (two of which occur on Colonsay) and two pre-1970 10-km squares. However it is still included on the Joint Nature Conservation Committee database as a B.R.D.B. species.

The plant is small (10–35 cm) and mid green in colour. Vegetative growth is usually followed by flowering in August. All these factors mean that it is virtually impossible to locate except when in bloom. Single spikes can sometimes be difficult to detect in tall vegetation, even then. The number of flowering spikes present at any one site varies greatly from year to year. In order to try to provide baseline data that could be used to detect long term changes in overall population levels, a survey of the Scottish sites was coordinated in 1995 by Scottish Natural Heritage and The Royal Botanic Garden, Edinburgh.

As part of this survey, visits were made in August 1995 to known *Spiranthes romanzoffiana* sites on Colonsay, i.e. sites in one of the three following categories: a. in the Biological Records Center database; b. noted or collated in the 1989 survey conducted by Mr Frank Horsman; and c. discovered by the author and his wife in 1992 or 1993. A site is here defined as a location where spikes of *Spiranthes romanzoffiana* occur within a few metres of each other, separated by tens (usually hundreds) of metres from the next plant or group of plants. In 1995 *Spiranthes romanzoffiana* was flowering at nine sites with a mean of 2·0 spikes per site, range 1–5. *Spiranthes romanzoffiana* was not flowering at the three category c sites i.e. discovered in 1992 or 1993. Similarly at 18 out of 23 (78%) of the previously recorded sites (categories a & b) no flowering was observed and hence no plants detected. Five completely new sites were discovered in 1995 (category d). In 1989 Frank Horsman found nine sites with plants in bloom. In the 1995 survey ten sites with flowering spikes were located (nine with flowering spikes intact, and one where spikes were reliably reported but had disappeared at the time of the visit). The mean height of 18 plants was 19·5 cm, range 12–34 cm. Basal lateral buds (which can be an important means of reproduction; Summerhayes 1968) were only observed on two plants.

Plant species lists with abundance values were drawn up for twelve sites (i.e. including the three category c sites where the precise location of the plant in 1992 or 1993 was known) and National Vegetation Classification (N.V.C.) communities (Rodwell 1991) allocated to each stand (Table 1).

TABLE 1. NATIONAL VEGETATION CLASSIFICATION COMMUNITIES AND SUB-COMMUNITIES AT TWELVE SITES AT WHICH *SPIRANTHES ROMANZOFFIANA* HAD FLOWERED IN 1992 (ONE SITE), 1993 (TWO SITES) OR 1995 (NINE SITES)

Code	Community and sub-community	Number of stands
M6	*Carex echinata—Sphagnum recurvum* mire	
M6d	*Juncus acutiflorus* sub-community	2
M10	*Carex dioica—Pinguicula vulgaris* mire*	
M10a	*Carex demissa—Juncus bulbosus/kochii* sub-community*	1
M23	*Juncus effusus/acutiflorus—Galium palustre* rush pasture	
M23a	*Juncus acutiflorus* sub-community	3
M23b	*Juncus effusus* sub-community	2
M25	*Molinia caerulea—Potentilla erecta* mire	
M25a	*Erica tetralix* sub-community	2
M25a/b	Intermediate between *Erica tetralix* and *Anthoxanthum odoratum* sub-communities	1
M25b	*Anthoxanthum odoratum* sub-community	1

* This stand only matched M10a approximately.

At five sites the stand showed a strong affinity to a second N.V.C. community. Many species were common to several stands. Allocation of stands to any one community was often therefore based on changes in the abundance levels of critical species, e.g. *Juncus acutiflorus* and *Molinia caerulea*.

Horsman (1994) states "this is a plant [*Spiranthes romanzoffiana*] with a distinctive habitat, this being the *Molinia caerulea* carpet, on old lazy beds, grazed by cattle." At only one of the overall total of 13 sites studied in detail were lazy beds present. However, *Molinia caerulea* did occur at most of these sites, at varying levels of abundance. In fact the variety of phytosociological associations in which the plant was recorded make it very difficult to define a typical *Spiranthes romanzoffiana* habitat in vegetational terms, though all are essentially wetland associations.

For 13 of the 21 plants recorded (20 flowering and one vegetative) one or two of the basal leaves had been affected by previous grazing; eleven had at least one stem leaf partly grazed. At the time of the visit, one flowering spike had been 'detached' by slug grazing and two by rabbit grazing. One spike 'disappeared' between a first and second visit, probably due to sheep grazing (time interval 13 days). Two spikes 'disappeared' two days after having first been observed by the crofter, probably due to rabbit grazing, as there were no stock in the field. In addition two spikes disappeared at one site grazed by sheep and cattle over a 31 day interval. The severance of flowering spikes was a very obvious field factor, but may not necessarily be critical at the population level. On the other hand the overall effect of the annual cycles of grazing and trampling, the intensity of grazing and trampling, and year-to-year variations in these factors on the growth, vegetative reproduction, seed production, establishment and levels of competition is probably extremely important. Conservation management for *Spiranthes romanzoffiana* would be fairly easy to arrange (given appropriate financial incentives) at enclosed sites. However at the extensive sites, i.e. where stock roam over large areas, it would be extremely difficult to organise. Six of the total of 13 sites were subject to extensive (unenclosed) grazing. As far as can be ascertained, 13 of the 23 sites from which the plant has been previously recorded were unenclosed.

The mean number of plants in bloom at the 13 sites was 2·0; and at the three new sites found in 1992–1993 (c), no flowering at all occurred in 1995. 1995 may well have been atypical, as many sites were drier than usual. Furthermore a low growth of herbage generally could have resulted in an overall intensification of grazing pressure. At one site and its environs, visited in 1991, 1992, 1993 and 1995, the number of flowering spikes recorded was 6, 1, 1 and 3 respectively. Monitoring population levels over a number of years will allow the degree of annual fluctuation in number of plants in bloom per site and the number of sites to be quantified absolutely. This will help to establish whether new locations recorded in both 1992–3 and 1995 reflect a genuine tendency of the species to continue to occupy new sites while simultaneously becoming locally extinct at others, or simply reflects a previous lack of knowledge on the plant's distribution on Colonsay. Once these

questions have been answered, it will then be possible to determine whether the long term trend for the species is one of expansion, contraction or stability. It is to be hoped that funding will be available to allow this important research to be carried out.

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THE CORRECT AUTHORITY FOR LESSER CHICKWEED, *STELLARIA PALLIDA* (CARYOPHYLLACEAE)

The combination *Stellaria pallida*, based on *Alsine pallida* Dumort., is attributed to Louis Piré (*Bulletins de la Société Royale de Botanique de Belgique* **2**: 49 (1863)) in all standard Floras of Britain and Europe (cf. Ascherson & Graebner 1991; Clapham, Tutin & Warburg 1962; Hegi 1969; Greuter, Burdet & Long 1984; Rechinger 1988; Blamey & Grey-Wilson 1989; Romo 1990; Stace 1991; Kent 1992; Chater & Heywood 1993, as a few examples). Lesser Chickweed extends to Arabia and while proof-reading its treatment in Vol. **1** of the forthcoming *Flora of the Arabian Peninsula and Socotra* (Miller & Cope in press) I noticed that Piré's accent had been omitted and consulted his original publication. In so doing I became acutely aware that the combination *Stellaria pallida* (Dumort.) Piré is invalid under the current *International Code* (Greuter et al. 1994).

Piré's paper (Piré 1863) is concerned with the occurrence of the species in France and its conspecificity with *Stellaria boreana* Jord. Throughout, including the title and the caption to the excellent colour plate (facing p. 49), Piré consistently refers to the species as *Alsine pallida*. On p. 48, he provides a conspectus in which he recognises two genera: *Stellaria* with three species (*S. holostea* L., *S. glauca* With. and *S. graminea* L.) and *Alsine* with four (*A. media* L., *A. pallida* Dmtr., *A. neglecta* Dmtr. and *A. nemorum* L.). [Nomenclature and citation of authorities are Piré's.]

It is only at the very end of the paper that the combination *S. pallida* appears. Piré's text reads: "Nous croyons donc que le nom d'*Alsine pallida* Dmtr. doit être préféré à celui de *Stellaria Boreana* Jord. Si cependant on n'admettait point le genre *Alsine* et si l'on persistait à laisser cette espèce dans le genre *Stellaria*, je proposerais de la nommer *Stellaria pallida*, conservant ainsi le nom spécifique que a la priorité." This translates as follows (italics, other than for scientific names, are mine): We therefore believe that the name of *Alsine pallida* Dmtr. must be preferred to that of *Stellaria*

Boreana Jord. *If however one did not accept* the genus *Alsine* at all and *if one persisted in leaving this species in* the genus *Stellaria*, *I would propose* to name it *Stellaria pallida*, in this way keeping the specific name that has priority.

It is quite clear that Piré *did* accept *Alsine* as a genus distinct from *Stellaria*. His use of the future conditional tense ("je proposerais . . ."), and his use of *Alsine pallida* in preference to *Stellaria boreana*, also makes it very clear that he did not, at the time of publication, accept a circumscription of the genus *Stellaria* that embraced *Alsine* L. Thus, his proposal of the name *S. pallida* is contrary to Art. 34.1(b) of the *Code*, which states, "A name is not validly published . . . when it is merely proposed in anticipation of the future acceptance of the group concerned, or of a particular circumscription, position, or rank of the group (so-called provisional name)". Hence his combination in *Stellaria* must be deemed invalid. Indeed, it seems to be a text-book example of when this Article of the *Code* should be applied.

The earliest valid publication of the epithet *pallida* under *Stellaria* that I have traced (via Ascherson & Graebner (1919)) is in Murbeck (1891) where the name appears as "*S. pallida* DUMORTIER Florula Belgica, p. 109 (1827), sub *Alsine*; Piré in Bull. de la Soc. bot. de Belg., tom. II, p. 49 (1863) cum icone; F. Schultz Herb. norm. nov. ser., cent. 8 n. 755." In Murbeck's work the genus *Stellaria* is accepted in its present-day circumscription, including *Alsine* L. I have not managed to establish whether publication of the name on F. W. Schultz's *Herbarium normale* exsiccata (n.s. Cent. 8, no. 755), issued by K. Keck in c. 1881 and cited by Murbeck, was effective or valid (with inclusion of the basionym *Alsine pallida*), as I have not seen an example of the specimen. Hence, unless an earlier valid publication of *S. pallida* can be traced (none is indicated in the extensive citations provided by Ascherson & Graebner 1919), the name of this species should henceforth be cited as:

Stellaria pallida (Dumort.) Murb., *Lunds Universitets Års-skrift* **27**(5): 158 (May 1891).
BASIONYM: *Alsine pallida* Dumort., *Florula Belgica* 109 (1827–29).
SYNONYM: *Stellaria pallida* (Dumort.) Piré, *Bulletins de la Société Royale de Botanique de Belgique* **2**: 49 (1863), comb. inval.

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HYDROCHARIS MORSUS-RANAE L. (HYDROCHARITACEAE) FRUITED IN BRITAIN IN 1995

Hydrocharis morsus-ranae L. (Frogbit) is a floating aquatic which, like many such species, has an effective method of vegetative reproduction (Cook & Lüönd 1982). Turions are produced throughout the growing season as terminal buds on slender stolons. Those which arise in spring and summer remain attached to the stolon and develop immediately into young plants; a colony of *H. morsus-ranae* often consists of groups of plants connected by rather fragile stolons. The turions (sometimes called hibernacula or winter-buds) which arise in autumn have a distinct abscission layer at the junction with the stolon and are readily detached. They are initially dormant and sink to the bottom of the water, growing into new plants in the spring.

Individual rosettes of *H. morsus-ranae* bear either male or female flowers. Scribailo & Posluszny (1984) found that most plants were dioecious, i.e. all the rosettes derived from them were male or all were female. However, 5–10% of plants were monoecious, giving rise to some male and some female rosettes. After flowering the peduncle curves down into the water, where the fruits mature. However, fruiting plants of *H. morsus-ranae* are rarely encountered in the native range of the species, probably because some colonies are exclusively male or female, and even if both sexes are present flowering may be very erratic. The factors which are required for flowering have not been studied critically, but Cook & Lüönd (1982) suggest that few flowers are produced if either climatic or local habitat conditions are unfavourable. In Britain Syme (1869) stated that "the fruit is apparently rarely perfected, as, although I have frequently looked for it, I have never been able to find it mature . . ." and Hooker (1870) commented more tersely that "*Fruit* I have not seen". Arber (1920) reported that although flowers are not uncommon, "seed is hardly ever set in this country. The ripened seed vessels are to be found, however, in Continental stations . . .". Successive editions of Clapham *et al.* (1952) say that the fruit is "rarely if ever produced in this country". The fruits of *H. morsus-ranae* are not described by Clapham *et al.* (1952), Dandy (1980) or Stace (1991).

Despite the statements in the literature cited above, there is some evidence that *H. morsus-ranae* does fruit periodically in Britain. A fruiting plant was illustrated by Butcher (1961) in a plate based on material collected at Wicken Fen, Cambs. (v.c. 29). It is difficult to assess the maturity of fruits on pressed herbarium specimens, but specimens in **BM** collected at the following sites apparently have mature fruits containing seeds: Amberley Wild Brooks, W. Sussex, v.c. 13 (*B. Welch*, 30 August 1953); Wey Navigation Canal between Weybridge and Byfleet, Surrey, v.c. 17 (*M. B. Gerrans*, 10 August 1947); Thorpe, E. Norfolk, v.c. 27 (*H. D. Geldart*, July 1852); River Ant near Barton Broad, E. Norfolk, v.c. 27 (*J. Groves*, 2 August 1897); Lousy Bay, Sutton Broad, E. Norfolk, v.c. 27 (*R. Gurney*, September 1947); a pond near the River [Great] Ouse near Elford Closes, Stretham, Cambs., v.c. 29 (*J. E. Dandy & G. Taylor*, 19 August 1932). There is also a fruiting specimen in **LTR** from a ditch near Ingham, E. Norfolk, v.c. 27 (*T. G. Tutin*, 4 August 1951, fide R. J. Gornall), but there are no fruiting specimens in **CGE**. The most detailed account of the fruiting of *H. morsus-ranae* in Britain is that of Gurney (1949), who reported that the species was exceptionally abundant in Norfolk in the summer of 1947, and flowered more freely than usual. A large proportion of the flowers set seed, which Gurney attributed to the "remarkably fine sunny weather" of the summer of 1947.

The summer of 1995, like that of 1947, was exceptionally warm and sunny (Branson 1995). We therefore examined populations of *H. morsus-ranae* in ditches in East Anglia in September 1995 to see if there was any evidence of fruit production. We found well-formed fruits at three of the four populations we examined. At Nene Washes, Cambs. (v.c. 29), and Woodwalton Fen, Hunts. (v.c. 31), fruiting plants were frequent in at least some ditches, and at Ludham Marshes, E. Norfolk (v.c. 27), plants were fruiting sparingly. We found only two small fruits, however, in the large population growing in apparently similar habitats at Swavesey, Cambs. (v.c. 29). As the flowers of *H. morsus-ranae* have disappeared by September, it is not possible on a single visit in the autumn to investigate the reasons why plants do not have fruit. Plants may have failed to fruit because they did not flower, or are male, or are females growing in a single-sex population, or are female plants in a mixed-sex population which failed to be cross-pollinated or which were cross-pollinated but failed to set seed for climatic or other reasons. It is also impossible to assess the proportion of female flowers which set seed.

In September and October 1995 C. Mainstone and P. R. Green kindly examined populations of

H. morsus-ranae in ditches in the Lewes Levels, E. Sussex (v.c. 14), and Westonzoyland, N. Somerset (v.c. 6), respectively. The plant was fruiting in both localities.

The fruits of *H. morsus-ranae* which we examined were borne on slightly curved, arcuate, or rarely sinuous, spongy peduncles 36–116 mm long and 2·0–3·3 mm in diameter. The fruits were ellipsoid, obovoid or globose, occasionally asymmetrical, smooth or with six ribs where the carpel walls showed through, and truncate at the apex with a circular black scar where the stigmas had been attached. They measured 8·0–11·4 × 4·0–9·6 mm. The seeds had characteristic blunt tubercles similar to those illustrated by Scribailo & Posluszny (1985). Both peduncles and fruits were green with a reddish brown or brown tinge, the fruits becoming brown with age. The turions, which were more frequent, differed in their narrowly ovoid shape and obtuse apex; they measured 6·1–13·5 × 2·6–5·6 mm and initially were green with faint or distinct reddish streaks along their length, but turned brown with age. They were borne on straight, slightly curved or arcuate stolons (3·9–)40–150 mm long and only (0·6–)1·0–1·9 mm in diameter. The stolons were slightly constricted at the junction with the turion, and eventually this junction curved so that the turion was held at an angle of 90° to the stolon; at this stage it was very easily detached.

The number of well-developed seeds in a random sample of fruits from each population was counted, and the results are presented in Table 1. Many fruits also contained numerous small, transparent seeds which are not included in the totals presented. We know of no comparable figures for Europe, but *H. morsus-ranae* is naturalised in North America and the numbers of seeds set by naturally-pollinated and hand-pollinated flowers in a Canadian population were measured by Scribailo & Posluszny (1984). Their figures are also reproduced in Table 1. The mean number of seeds per capsule in the Canadian population is similar to ours, but there appears to be more variation between fruits in the British sites.

The ease with which we discovered fruits of *H. morsus-ranae* suggests that they may be produced by many populations in Britain, at least during hot summers. They are likely to be found only if deliberately searched for, as they are held beneath the surface of the water. However, fruit production is not necessarily followed by the germination and establishment of seed. Scribailo & Posluszny (1985) were able to germinate seed of *H. morsus-ranae* under experimental conditions, but they only found two seedlings in the wild despite the fact that at their study site some 250 seeds/m^2 were produced in the preceding summer. However, they pointed out that the floating seedlings were easily confused with the duckweeds *Lemna minor* L. or *Spirodela polyrhiza* (L.) Schleiden (although the duckweeds differed in having roots arising directly from the lower surface of the leaf). Serbanescu-Jitariu (1972) reported seedlings from Romania in sites where *H. morsus-ranae* fruited freely for several years in succession. Further observations are required to establish whether *H. morsus-ranae* reproduces by seed in Britain. However, there can be no doubt that vegetative propagation is overwhelmingly important in this species.

TABLE 1. LOCALITIES WHERE FRUITING *HYDROCHARIS MORSUS-RANAE* WAS FOUND IN SEPTEMBER AND OCTOBER 1995, WITH DATA ON THE NUMBER OF SEEDS PER FRUIT AND A COMPARISON WITH CANADIAN DATA PUBLISHED BY SCRIBAILO & POSLUSZNY (1984)

Locality	Grid reference	No. of fruits examined	No. of well-formed seeds per fruit		
			Range	Mean	S.D.
Westonzoyland, v.c. 6	ST/3.3	2	14–59	37	—
Lewes Levels, v.c. 14	TQ/424.054	15	4–56	31	15
Ludham Marshes, v.c. 27	TM/407.180	15	4–96	36	28
Nene Washes R.S.P.B. Reserve, v.c. 29	TL/276.992	15	4–43	26	12
Middle Fen, Swavesey, v.c. 29	TL/35.70	2*	1	1	—
Woodwalton Fen N.N.R., v.c. 31	TL/233.849	30	1–74	42	18
Rondean Park, Lake Erie, Ontario, Canada					
1. naturally pollinated flowers		47	15–53	33	
2. hand pollinated flowers		29	7–47	32	

* only two small fruits found. S.D. = standard deviation.

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IS *GENTIANELLA ULIGINOSA* (WILLD.) BOERNER (GENTIANACEAE) PRESENT IN ENGLAND?

Dowlen & Ho (1995) drew attention to an over-looked specimen of *Gentianella ciliata* (L.) Borkh. from Wiltshire in the British herbarium at the Natural History Museum, London (**BM**). The herbarium also holds some specimens of *Gentianella uliginosa* (Willd.) Boerner from England. The purpose of this note is to draw attention to them to see if they can be refound in the field or clarify if they are correct.

DEVON (V.C. 4)

There are two sheets from Braunton Burrows, North Devon both determined by T.C.G.R.

The first record is based on a single specimen labelled "on Braunton Burrows" in **herb. E. Forster** which is undated but must have been collected before her herbarium was acquired in 1849. The specimen has the characteristically strongly out-curved calyx segments and a corolla 17–18 mm long. The basal rosette has two stems each with one long internode, a single leaf at the node and two flowers, and three flowers on pedicels arising directly from the rosette. The specimen is rooted in sand with a few shoots of a grass which appears to be *Agrostis stolonifera* L. It was originally labelled *G. amarella*, and I am unsure of the identity of the second specimen mounted with it.

The second record is based on *Gentianella* specimens labelled as collected by I. A. Williams on 8 September 1927 from Braunton Burrows. The specimens, presumably from one collection, were originally named as "*G. anglica*" but had been separated on to two sheets by A. J. Wilmott in 1949.

On one sheet there are four small plants in full flower which are *Gentianella anglica* (Pugsl.) E. F. Warb., as labelled. The second sheet has two large plants with very long internodes and unequal, spreading sepals, and are clearly *Gentianella uliginosa*. It is possible that the material may have been mislabelled, as *G. anglica* has never otherwise been observed flowering in the autumn. I. A. Williams was a reliable botanist who collected widely from Surrey to mid-Wales and Scotland; his obituary was given by Lousley (1962).

There are no other known records for Braunton or North Devon (J. Breeds and W. H. Tucker, pers. comm. 1995). Braunton has been extensively botanised in the past by well-known botanists such as H. W. Pugsley, F. R. E. Wright, W. P. Hiern and more recently by J. E. Lousley, L. J. Margetts and N. M. Pritchard, and it is surprising that it has not been refound. The dunes were visited again in 1995 specifically to look for *G. uliginosa* on 12 June and 20 September and an extensive search made of the dune slacks which looked similar to the South Wales sites. Whilst both *G. anglica* and *G. amarella* were found, there was no sign of *G. uliginosa*. Presumably it could reappear from buried seed uncovered by shifting sands, and it should be looked for again.

G. uliginosa is well known in South Wales on the opposite side of the Bristol Channel, and the North Devon record would fit the distribution pattern as also shown by other rare dune species such as *Matthiola sinuata* (L.) R. Br. and *Liparis loeselii* (L.) L. C. M. Richard. Interestingly, Pritchard (1959) suggested that the Bristol Channel race of *G. amarella* showed some features suggesting past introgression with *G. uliginosa*.

DERBYSHIRE (V.C. 57)

Lousley (1950) noted that *G. uliginosa* was listed for v.c. 57 by R. Wettstein in 1896 but further evidence for its occurrence was unknown. There is, however, one sheet of *G. uliginosa* from Buxton, Derbyshire, collected on 24 July 1898 by L. F. Blake. The material has unequal, out-curved sepals and very long terminal or second to terminal internodes; it was confirmed by T. N. Ho in 1992 and appears to be correctly named. Little appears to be known about Blake.

Clapham (1969) rejected Linton's (1903) record from Millers Dale; no material has been seen. The occurrence of two records from the Peak District suggests a more careful examination of *Gentianella* in damp meadows would be worthwhile.

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Book Reviews

Insects, plants and set-aside. B.S.B.I. Conference Report no. 23. Edited by A. Colston & F. Perring. Pp. 55. Botanical Society of the British Isles, London. 1995. Price £6.50. ISBN 0–901158–26–7.

This is a report of the B.S.B.I. conference on set-aside, which was hosted by the Royal Entomological Society on 14 April 1994.

Set-aside covers about 500,000 ha in Britain; its introduction is a major ecological event, especially important in the south-eastern half of England where arable farming predominates. Its purpose is to reduce significantly the production of arable crops: environmental gains have to be achieved within that context. As Stewart Lane makes clear, set-aside regulations are extremely complicated and are changing. Nevertheless, all six contributors to this report believe that considerable conservation gains can be achieved if objectives are adequately targeted.

Terry Wells describes the floristic sequence of set-aside from the first year when annuals predominate to the fifth year when perennials have taken over. He states that species-rich grasslands can only be achieved by sowing suitable mixtures; he describes experiments on establishing wild flowers on heavy clay and chalk.

L. G. Firbank and P. J. Wilson remind us of the important contribution arable land makes to biodiversity in Britain. They emphasise that farmers should be made more aware of the value of set-aside for conservation, especially on lighter soils.

In an interesting paper on the genetic consequences of set-aside Quentin Kay puts set-aside in its historical context, showing its relationship to land abandonment, fallow with cultivation, changing crops and using land for non-agricultural purposes. In emphasising the importance of differences in biotypes and the speed of selective responses, he warns of the dangers of introducing unsuitable strains in wildflower mixtures. Some effects of set-aside may be permanent.

Sawflies are the most important food for partridge chicks. S. J. Moreby and N. W. Sotherton show that there were no significant differences in sawfly populations of winter wheat and set-aside. Five other invertebrate groups were more numerous in set-aside and four in winter wheat. Vegetation structure is as important as invertebrate density and diversity for partridge chicks.

Sarah A. Corbet relates set-aside to "islands" of established perennial vegetation. She concludes by saying that "long-term set-aside offers an opportunity to begin to rebuild some of the semi-natural communities that have suffered the most serious decline."

In the final discussion Tim Allen of the Countryside Commission warns that we must expect less from set-aside than from the more targeted agro-environmental measures such E.S.A.s and the Stewardship Scheme. Sarah Hendry of M.A.F.F. shows how the UK has helped to make set-aside more useful for conservation and has adapted policy to environmental concerns. Sarah Webster of the Department of the Environment emphasises the need for conservationists to define more exactly the environmental requirements which could attract environmental payments, and to monitor their effectiveness.

It is too soon to be able to outline what effects set-aside has had or will have on the flora and fauna of Britain. This slim volume outlines possibilities and some dangers. It makes it clear that conservationists should consider set-aside seriously as a means of conserving an underestimated and seriously threatened part of our flora and fauna. It is a valuable introduction to a complicated and difficult subject.

N. W. Moore

Wildlife in church and churchyard. N. Cooper. Pp. viii + 63. Church House Publishing, London. 1995. Price £6.95. ISBN 0–7151–7574–2. Obtainable from The Council for the Care of Churches, Fielden House, Little College Street, London SW1P 3SH for £7.50 incl. p. & p.

The three editions of *The churchyards handbook* in 1962, 1976 and 1988, and G. M. A. Barker's *Wildlife conservation in the care of churches and churchyards* in 1977, reflected very clearly the

growing awareness within the Church of England of the significance of wildlife conservation. The present booklet, by the Rector of Rivenhall in Essex, marks a further stage in this evolution, recognising that "there are many people within the Church, and many more without, who are looking for a new attitude to the world in its fragility and for a congruent lifestyle." Churchyards, it says, "can aim to be places where the human needs of those who use the churchyard and value its historic treasures, and the needs of plants and animals for a home, are in balance." It is intensely practical, covering everything from preliminary surveys and simple, down-to-earth management plans to compost heaps, grass-cutting machinery and where to apply for grants. The table of different grassland management regimes is outstandingly clear and helpful, and is one of many features which should recommend the booklet to anyone interested in properly managing all sorts of small areas of land, including wildlife gardens and nature reserves. To the general reader unfamiliar with the botany of churchyards the ecological diversity of these places will come as a revelation.

Among many valuable suggestions are those concerning the designation of churchyards as Sites of Importance for Nature Conservation (S.I.N.C), and the desirability of appointing ecologists to Diocesan Advisory Committees. Various ways are described in which local naturalists can get involved with churchyards. My only serious complaint is over the author's quite uncharacteristic description of knapweed as a weed requiring removal or suppression, an unfortunate instruction for a churchyard with a proud display of this indicator species in its precious relic of MG5 grassland. The B.S.B.I. is not mentioned among sources for further advice, but Plantlife is, and the Living Churchyard Project is rightly identified as the hub of churchyard conservation.

A. O. Chater

Vascular plants of Russia and adjacent areas (the former U.S.S.R.). S. K. Czerepanov. Pp. x + 516. Cambridge University Press, Cambridge. 1995. Price £60.00. ISBN 0–521–45006–3.

In 1981, Sergei Czerepanov published (in Russian) a critical check-list of the flora of the area covered by Komarov's *Flora S.S.S.R.* under the title *Plantae Vasculares U.R.S.S.* The present work is a revised and taxonomically updated edition of this work, in which the families, genera, species, subspecies and varieties of the vascular flora (including ferns) are listed alphabetically along with the names of hybrid species and genera.

The flora of the former U.S.S.R. encompasses 21,770 species within 1,945 genera and 216 plant families, a formidable percentage of the world's vascular flora from territories which include many centres of endemism such as the Caucasus, East Siberia and the Central Asian republics. According to the preface, 594 hybrids with binary names are also treated. One of the most valuable features of the list is the synonymy, which allows the user to consult a single reference work rather than a plethora of regional Floras. The regions from which species and subspecies have been recorded are indicated by the numbers 1–5 (Eastern Europe including European Russia, Caucasia, Western & Eastern Siberia, the Far East and Middle Asia).The Arctic region is no longer recognised as a separate unit.

Very occasionally, short explanatory notes are included: for example, under *Potamogeton henningii* A. Benn. is the comment "Mysterious species. The critical investigation is necessary." Square 'bullets' are deployed in the text alongside the names of 203 species which, while not recorded from within the territories covered, may be expected to be found there.

This work will be of great benefit to Flora writers, monographers and particularly herbarium curators; it will also be of use to anyone visiting the countries of the former U.S.S.R. who is using one of the local Floras or keyed lists which has a narrow species concept. With this meticulously compiled list, names used in Floras of adjacent areas as well as those used in more recent revisions can be reconciled with treatments published earlier. Its publication also constitutes a major step towards compiling a world check-list of accepted names of vascular plants.

J. R. Edmondson

Kew. The history of the Royal Botanic Gardens. R. Desmond. Pp. xvi + 466. The Harvill Press, London. 1995. Price £25.00. ISBN 1–86046–076–3.

Kew, as we all know, is the premier botanic garden in the world. There are approximately 40,000 taxa in cultivation, representing about 10% of the world's vascular plants. The herbarium of almost 7,000,000 specimens underpins the living collections, and provides a priceless resource for botanists from traditional taxonomists to practitioners in the new disciplines of biotechnology. Kew's library is also a fundamental resource, and its archives are a treasury of material on the progress of botany and horticulture worldwide.

In the beginning, the ground where the Royal Botanic Gardens are now firmly rooted was occupied by a series of royal pleasances without scientific pretensions. The greatest landscape gardeners and architects of the eighteenth century were severally commissioned to embellish these royal properties with lawns, trees and follies. By 1759 a physic garden had been formed within Princess Augusta, the Princess of Wales's garden. This was, grandiosely, "destined for Botany . . . [and] was to contain all the plants known on earth". William Aiton was brought from Chelsea Physic Garden to care for the plants, and thereby Kew's reputation as a botanic garden began. Aiton built the collections by a variety of means, including purchases from nurserymen, so that by 1768 when John Hill published *Hortus Kewensis* he was able to catalogue about 3,400 species.

By the late 1830s the state of the Royal Gardens at Kew caused public concern. A commission was established to decide their future; there was a period of "rumour and innuendo, of Government duplicity, of public bewilderment and apprehension". On 25 June 1840, the Gardens were transferred to the charge of the Commissioners of Woods and Forests, and four days later Sir William Hooker was appointed Director of the Royal Botanic Gardens. Thus the modern scientific garden came into being.

Kew's custodians, gardeners and scientists have always been outward looking. This book recounts the garnering of seeds and plants from newly explored lands and the subsequent dispersal of important economic plants to outstations in the colonies during the late eighteenth and nineteenth centuries. A striking aspect of the Gardens' history is the fact that Kew's "grounds for botanizing" have always lain well beyond the British Isles. The sobriquet "Imperial Kew" was very apt, considering, for example, that at the beginning of this century "about 160 former Kew employees [were] serving in Asia, Africa, Australia and America, the majority in senior posts". Nowadays, working with botanists of other nations, Kew's mission is still mainly extra-European, enabling "better management of the earth's environment by increasing knowledge and understanding of the plant kingdom – the basis of all life on earth." Kew encourages exploration, assists in the preparation of much-needed Floras and endeavours to conserve endangered plants.

This splendid history has been long-awaited. The story of "Imperial Kew" fills a handsome volume of over 500 pages, with numerous black-and-white illustrations and 32 pages of colour plates. There is an ample index, and the usual scholarly apparatus of bibliography and notes. The author, who was for many years Chief Librarian and Archivist at Kew, has composed 15 appendices to contain, in nutshells, some of the essential information about Kew and its progress. Thus, Appendix 1 contains basic data: acreage, buildings, the oldest and tallest trees, and the numbers of living and preserved specimens. Appendix 2 is a succinct chronology of the Gardens, beginning in 1631 when Kew Palace was built; an invaluable feature of this appendix is the inclusion under the relevant year of publications by staff. Other appendices provide, for example, accounts of trees, ornamental ironwork and sculptures, and biographies of "monarchs, statesmen, administrators, scientists, gardeners, plant collectors, architects [and engineers] and artists" associated with the place.

Ray Desmond's *Kew* is a compendious book, irreproachable in its scholarship, a work worthy of the diligent author and of the Gardens, and, moreover, a thoroughly enjoyable book to read.

E. C. Nelson

The Flora of Northamptonshire and the Soke of Peterborough. G. Gent, R. Wilson *et al*. Pp. 335. Robert Wilson Designs, Rothwell. 1995. Hardback £30.00, ISBN 0–907381–03–0. Paperback £23.00, ISBN 0–907381–08–1.

The publication of this new *Flora of Northamptonshire and the Soke of Peterborough* is the result of enthusiastic plant recording by a group of amateur botanists of the Kettering and District Natural History Society. They discussed the possibility of a new Flora as early as 1953 when it was felt that the Flora of Dr George Claridge Druce published in 1930 was seriously out of date, particularly as some of his records had been collected in the nineteenth century.

Northamptonshire, v.c. 32, now called the Rose of the Shires, was known in the days of Druce as the County of Shoes, Squires and Spires. It occupies an area of some 2500 km^2 in central England and is bordered by eight other counties. It would have been helpful to include a map showing its location. The Soke of Peterborough was in fact 'lost' to the administrative county of Huntingdonshire in 1965 but the authors felt it important to include the area both as an update of Druce's *Flora* and as a complete record of v.c. 32.

There was controversy over the best way to record. Druce had been chauffeur-driven around the countryside and had noted the flora from the back of his Daimler! Clearly, times had changed. The group eventually decided that it should record on a grid-square basis but was unable to decide whether to adopt a 2-km or a 5-km square. After some trials for both, a decision was made in 1970 to proceed with 5-km square recording as the number of botanists involved in the project was very small and the additional work for 2-km square recording would be too much for them. As most recent county Floras have used 2-km or tetrad recording it is questionable whether this was a sound decision, but if it was the only way to produce a new Flora then, of course, it was justifiable.

The introductory essays on Northamptonshire botanists, Climate and Landscape all deal with subjects covered by Druce. However, the essay on Plant Habitats is a useful addition and draws our attention to some particularly important plant niches in this county and is accompanied by 16 colour plates. Limestone quarries are often areas of major botanical interest. Barnack Hills and Holes with its abundant Pasqueflowers and rich assemblage of species was the quarry from which the stone for Peterborough Cathedral came. The iron ore quarries of Victorian times, although now largely restored to arable land, have created areas of disturbed ground which have proved to be ideal for such plants as the Bee Orchid, *Ophrys apifera*, the species depicted on the front cover. We would not expect to have Spires and Squires without walls surrounding the churchyards and country estates in a county rich in limestone and ironstone. These walls provide good habitats for mosses, lichens and ferns.

We learn that aquatic habitats have changed a great deal since the time of Druce. The gravel workings in the Nene valley have created new habitats whilst others such as field ponds are decreasing. The canal flora has suffered from the increase of leisure boating but plant life has benefitted from the improvement of water quality in the River Nene and Ise. These habitat observations contain many useful plant references but are somewhat marred by the consistently mistaken spelling of some of the species names, e.g. *Cratageus monogyna*.

Changes in the county's flora are further considered in the last essay, 'What time hath stole away'. Northamptonshire has suffered the effects of 'progress' in much the same way as the rest of the country. Urban development and major road construction has resulted in loss of plant communities. Since we read that the message in the present Flora is "to deplore and resist avoidable deterioration" perhaps more could have been made of a comparison between species lost or gained since Druce's day. A list of presumed extinct species is given at the end together with a list of rare and extremely rare species.

The systematic account and distribution maps have been clearly presented in a compact way with as many as four maps and accounts to a page in some cases. The maps were produced using Alan Morton's DMAP program and give a general idea of the distribution of a species rather than the quantity of plants occurring. When trying to interpret the distribution maps it is sometimes helpful to refer to the general map of the county in Figure 1 but this proves to be rather too general and perhaps a series of more detailed maps would have been preferable. For example, it would be helpful to see all the waterways and waterbodies depicted more clearly.

The date of the first record and Druce's comments on abundance in his *Flora* are important inclusions. The distributional text is brief and localities only mentioned if particularly notable. As

the recording has been done by a group of botanists we are not given the names of individual recorders except in the case of the last record of an extinct species. We are told that the majority of the recorders live in the northern half of the county but that the aim has been for even coverage. It is certainly not apparent that it is otherwise.

In producing both the hardback and the softback edition of their Flora at the same time, the authors are possibly predicting that botanists will buy one for use in the field and one for the bookshelf. They are to be congratulated on publishing it as a celebration of the Kettering and District Natural History Society's 90th Anniversary and we can only speculate on how they will mark their Centenary!

J. M. Croft

Alpine flowers of Britain and Europe, 2nd ed. C. Grey-Wilson & M. Blamey. Pp. 377. Harper Collins, London. 1995. Price £12.99. ISBN 0–00–220017–1.

Since 1979 fellow botanists and plant lovers encountered on the mountains of the European Alps have almost always had in their hands – or rucksack – the *The alpine flowers of Britain and Europe*. That first edition has been very popular and easy to use, but now we have a revised and updated new edition, for which the authors have taken into account the research and study in the classification and nomenclature of alpine plants since 1979.

To the profusion of colour plates a few additions and corrections have been made where the artist and author felt that these were necessary. But in general the more sympathetic and less garish printing of Marjorie Blamey's paintings now shows their natural very pleasing colours, particularly in the pink flowers, and in this edition the texture of the more fragile petals is more discerningly shown. The new format has all the additional species included in the main body of the text with illustrations facing, for easier reference.

No grasses, sedges, rushes or ferns are included, but most flowering plants growing above 1000 m, from alpine meadows, rocks and screes, with trees and shrubs at the lower altitudes, are described and illustrated. The area covered, extended from the earlier edition, is centred on the mountain masses of central, south-western and eastern Europe, but also northern Europe, the British Isles and Iceland – from the Spanish Pyrenees to the Karawanken in Austria and the Julian Alps in Slovenia. A code for each country in the text now enables the distribution by country of each species to be instantly ascertained.

I would encourage all those familiar with the first edition to invest in this new edition, and only hope that with the increased number of pages the paperback binding will stand up to the hard wear to which many copies will undoubtedly be subjected by alpine travellers with interest in the flowers ranging from slight, but appreciative, to passionately detailed.

M. Briggs

Wild orchids of Hampshire and the Isle of Wight. M. N. Jenkinson. Pp. 198. Orchid Sundries, Gillingham. 1995. Hardback £24.95, ISBN 1–873035–04–7. Paperback £19.95, ISBN 1–873035–03–9.

This new book, covering one of the richest orchid hunting grounds in Britain, by Martin Jenkinson complements his earlier *Wild orchids of Dorset* (reviewed in *Watsonia* **19**: 157–158). It follows the same format and style but includes short chapters on Habitat Conservation and Management, Orchid Reproduction: Pollination, Germination and Growth, Hybrids, Albinos and Abnormals, Orchid Photography and The Future as well as the main species accounts. The new book also benefits from many more colour plates, all taken by the author either within, or close to, the county boundaries. There is much of interest in the plates with varieties, colour variations, hybrids, albinos and 'abnormals', many of which I have not seen illustrated elsewhere. Despite the author's claim that his use of flash achieves a consistent level of density of slides for publication purposes there is considerable variation in the exposure and quality of the plates.

There are 1-km square distribution maps for all species except Red Helleborine (*Cephalanthera*

rubra), Lizard (*Himantoglossum hircinum*) and Early Spider (*Ophrys sphegodes*) Orchids. For these last three species shaded 5-km squares are supposed to obscure the precise sites, but in all cases careful reading of the text and examination of the maps for other species mentioned as growing with these rarities enabled me to pinpoint the 1-km squares quite easily. As the author points out in his Introduction most such sites are so well known already that to be coy about them at this late stage is a case of locking the stable door after the horse has bolted. The section on Secrecy v. Education will provide food for thought for those managing rare orchid sites. My main concern with the distribution maps was the lack of labelling, which in several cases makes it very difficult to work out which species is covered. There is also no information on the date period covered by the maps or whether any specific surveys were undertaken to produce them.

The text is full of interest with much information drawn from the author's long experience in the field. His special interest in the *Dactylorhiza* group is evident and there is a particularly useful table showing distinguishing characters between the Leopard Marsh Orchid (*D. praetermissa* var. *junialis*) and hybrids of Southern Marsh Orchid (*D. praetermissa*) with the spotted orchids. Numerous references to Dorset at times make it read like a supplement to his first book but the text is always lively and readable. The author is not afraid to put down his own views and speculations and I commend him for doing so. I cannot share the optimism shown in the chapter on The Future but I am sure that this book, by bringing together so much new information about the orchids of this area, will greatly assist their conservation.

M. N. Sanford

Orobanche. *The European broomrape species. A field guide. 1. Central and northern Europe.* C. A. J. Kreutz. Pp. 159. Stichting Natuurpublicaties, Limburg. 1995. Price £40.00. ISBN 90–74508–05–7.

This is a slim, hard-backed A4-sized publication and is the first of two volumes with which the author intends to cover European members of the genus *Orobanche*. The format is dual-text in German and English which is achieved by dividing the pages vertically to accommodate each language.

A short introductory chapter gives a very brief outline of the systematic position, taxonomy, nomenclature and characteristics of broomrapes together with notes on physiology, ecology, distribution, crop damage and control. The main body of the book, which is described as the Specific Part, commences with diagrams showing the floral structures in *Orobanche*, followed by a key to the northern European members of the genus which has been taken almost entirely from that prepared by Gilli for Hegi's *Illustrierte Flora von Mitteleuropa*. It then goes on to describe in some detail 30 taxa, all but one of which are treated as species. These individual accounts comprise a morphological description of the species together with a note on flowering time, habitat, host and geographical distribution. Alongside each are drawings of corollas, stigmas, anthers and filaments, a map showing a tentative geographical distribution and, what is the most impressive feature of the book, a series of excellent colour photographs taken by the author.

Described as a field guide to the northern European broomrapes, this book attempts to fill a gap in the literature. It is, however, based on rather broad and outdated taxonomic concepts of the genus and is largely a re-working of old published material. For example, *Orobanche gracilis*, a very widespread, polymorphic European plant is treated so narrowly that its several, diverse and possibly subspecific variants would go unrecognised in the field and be attributed to other taxa. In contrast, in his doubtful separation (at species level) of *O. pallidiflora* from *O. reticulata*, the author makes no direct comparison between them in his descriptive section despite the overwhelming historical and taxonomic connection between the two. The British plant (referred to *O. reticulata* var. *procera*) is also included in the distribution map for *O. pallidiflora*, whilst var. *procera* itself is mentioned under *O. reticulata* but not shown for Britain. The descriptions of *O. alba* and *O. teucrii* state that there is a difficulty in their taxonomic separation; this is most surprising considering their very different corolla shapes. Several examples of incongruity exist including the presence in a book of northern European taxa of photographs of the strictly southern *O. densiflora*, *O. foetida* and *Cistanche phelypaea*. There is also a tendency to place undue reliance on the (presumed) host for identification purposes such as "*Orobanche flava* is easily recognised by its host . . ." and for *O.*

lucorum ". . . its presence under *Berberis vulgaris* is another clear distinguishing mark". Such information, if taken in relative isolation, is a dangerous practice in the identification of any *Orobanche*, especially so of the ones quoted. The book's broad-brush distribution maps contain many inaccuracies and should not be relied upon, as they indicate only very approximately the geographical areas in which the various taxa – some of them very rare – *might* be found.

Providing the above limitations are appreciated, this book should provide some useful identification aids for the British botanist venturing on to the Continent and wishing to know more about this difficult and sometimes critical genus. The author has a wide experience in photographing European orchids, and has now enlarged his field to include most of the northern European broomrapes. Without question his published photographs, many apparently flash-assisted, are of the highest quality but these will not necessarily be of value in identifying the various taxa.

M. J. Y. Foley

Pondweeds of Great Britain and Ireland. B.S.B.I. Handbook No. 8. C. D. Preston. Pp. 352. Botanical Society of the British Isles. London. 1995. Price £16.50. ISBN 0–901158–24–0.

It has been said the best way to evaluate a work on taxonomy is to redo it yourself and see if you agree. This is rather time-consuming. So, as second best, I gave this book to Swiss students attending a taxonomy course; they were given fresh plants (collected in winter) and herbarium specimens to identify. As a means to identifying pondweeds I have nothing but praise. The students got remarkably quickly to what I hope are the right determinations. The procedure is made easy. Two keys are provided: the first for species and common hybrids and the second for species and all recorded hybrids. The second key is very sensibly divided into six groups. Easily seen vegetative characters are used as leads in the keys, which makes the book very easy to use. Each taxon is given a description, an illustration, a distribution map and some notes on habitats and diagnostic features which may be used to distinguish it from similar looking taxa. The descriptions are long but uncluttered and use mostly simple Anglo-Saxon words, although a glossary of botanical terms is provided. The illustrations are excellent line drawings showing the general habit and various diagnostic features; they often cover one and a half pages but they are always kept together so one does not have to turn pages.

As a means for identifying pondweeds this work is very good but could it be made better? It might well sell better if it was made clear that 'pondweeds' means *Potamogeton*, *Groenlandia* and *Ruppia*. Although it is clearly entitled "of Great Britain and Ireland" it is of value to botanists outside the limits of the British Isles. An attempt to give distributions beyond the British shores for the individual species, rather than just the rather general account of world distribution in the Introduction, would be useful and even to 'Brits' perhaps interesting – none of the species is endemic to Britain and most are widespread. It makes the text perhaps neater to relegate synonyms to the index but, unfortunately, only the synonyms used in Britain are cited and all taxa below the rank of species are omitted. Confusing names are discussed in an introductory chapter but this information is not accessible from the index. The introductory chapters run to 116 pages; parts are interesting and important while others are just tedious. I would have hoped to see more internationally relevant work evaluated in the general chapters. Marjatta Aalto's excellent work on Fennoscandian species, in spite of being written in English, is dismissed in one rather sarcastic sentence. Poor Dr Fischer from Bavaria and Professor Fernald from America get no more than mentions. Although carried out in Germany, Professor Kohler's work on the ecological tolerances of pondweeds may also be relevant to British plants.

The major aim of this book is to identify pondweeds in Britain. This aim is clearly fulfilled. At £16.50 it is such a bargain that one can excuse some boring bits in the Introduction. Later, perhaps, an edition entitled "Pondweeds of Britain and Europe" might be considered.

C. D. K. Cook

Sand dune vegetation survey of Great Britain: a national inventory. Part 1: *England.* G. P. Radley. Pp. 126. £22.50. ISBN 1–873701–19–5. Part 2: *Scotland.* T. C. D. Dargie. Pp. 113. £16.00. ISBN 1–873701–20–9. Part 3: *Wales.* T. C. D. Dargie. Pp. 153. £26.00. ISBN 1–873701–21–7. All published by Joint Nature Conservation Committee, Peterborough. 1995. Special price for all three volumes £55.00. ISBN 1–873701–31–4 (set of three).

In many ways this is an interesting, indeed exciting, compendium of information about the vegetation of the sand dunes around the coast of Great Britain. Despite the co-ordinating role of J.N.C.C. and also given the special price offered for purchasers of the full set, the three parts are essentially three separate, although related, studies and reports. The value of the excellent work presented in these reports would have been greatly enhanced if the three national surveys had been properly brought together and presented in a common format. The nature of the problems are highlighted by the fact that Part 3 has a different ISBN number on the title page from that on the back cover. Not surprisingly, perhaps, the final part dealing with the Welsh dunes has the best presentation and format although it lacks the succinct conclusions and recommendations that conclude the English and Scottish reports. It is when reading the final part that the weaknesses in the earlier parts, and particularly the English part, become most evident.

If comparisons are made between particular vegetation types across Britain the inadequacies are clear. Taking as an example the N.V.C. Category SD9 (the whole project is based on the National Vegetation Classification) *Ammophila arenaria-Arrhenatherum elatius* dune grassland, we are given the areas of this community and the two sub-communities in England county-by-county in a table, with a distribution map of the rarer SD9b *Geranium sanguineum* sub-community. However, although the map occupies a full A4 page it only shows dots of differing size with the hint that the symbol size is proportional to the area. In contrast the Welsh part has a table of the distribution of this community and the sub-communities site-by-site and the distribution map not only has a quantitative key to the symbols but each symbol is given its site name and number.

This inconsistency also extends to the question of the basis on which sites were selected for inclusion. Part 3 covers 49 sites including individual sites as small as 2·97 ha. Part I covers 121 English sites including many small ones but there is no map of their location. Both these parts thus justify their title "Inventory". In contrast Part 2 covers 34 selected Scottish sites only, out of a total of over 300. This might have been slightly more acceptable if it had not been for the exclusion of several particularly notable Scottish sites including St Cyrus, Kincardineshire, the Monach Isles with over 300 ha of dunes and the absence of any sites from Orkney such as the 70 ha of Conninghole. If the many very small Welsh and English sites had been excluded it would have been possible to do justice to the many diverse and interesting sites north of the border; in no sense is Part 2 a national inventory.

In conclusion the three parts do provide valuable information on the vegetation of the British sand dunes and, given current book prices, represent reasonable value for money. It does seem a pity however that the opportunity was missed for co-ordinating the collection and presentation of data from the whole of Great Britain.

L. A. Boorman

Terrestrial orchids: from seeds to mycotrophic plant. H. N. Rasmussen. Pp. xii + 444. Cambridge University Press, Cambridge. 1995. Price £45.00. ISBN 0–521–45165–5.

This is a most welcome addition to the growing literature on orchids. It is not an identification guide to orchid species, nor is it concerned with their taxonomy, distribution or conservation, aspects of which are already covered by a variety of books which have been on the market for a number of years. Instead, it attempts to bring together much of what is known about the development of terrestrial orchids growing in temperate regions of the Northern Hemisphere. We all owe a great debt to the author, Hanne Rasmussen, from the Danish Institute of Plant and Soil Science, for finding, reading and extracting the nuggets from a huge, primarily European literature on orchids and for making available for English speaking biologists for the first time some of the gems which have remained mostly hidden in what have been, to most of us, rather obscure German texts and

papers. Anyone who has tried to read the lengthy papers by Fuchs and Ziegenspeck will know what I mean, yet they contain information of the greatest importance to orchid biologists. The author has also worked for a good number of years on orchids herself and this is apparent in the masterful way in which current research ideas are combined with information from the literature into a readable and interesting text.

The book is divided into 13 chapters which quite properly begin with the properties of orchid seeds, dealing with dispersal, nutrients, seed loss and predation. This is followed by chapters on seed and fruit development on the plant, seed survival and the requirements for germination and provides a useful summary of the enormous literature on this subject, much of which is anecdotal and not renowned for its scientific rigour. The pivotal role of fungi in the germination process and the problems associated with identification of the fungi involved, with fungal compatibility and specificity are discussed at length. Attention is drawn to the fact that we still have no clear idea as to the importance of the fungal associate in the mature plant although the role which the fungus plays in the nutrition of the protocorm and mycorhizome is now well-established. Since the young seedling of terrestrial orchids lives underground, the early life history is largely unknown although substantial progress has been made recently in this area using new techniques developed by the author and Dennis Whigham at the Smithsonian Environmental Research Institute. After chapters on life history and phenology, propagation, and the ecological consequences of orchid mycorrhiza, the book ends with a lengthy and important chapter in which the developmental processes of 39 genera of orchids are described and discussed at an individual generic level.

The strength of this book lies in the fact that it provides for the first time a comprehensive guide to the developmental processes of temperate terrestrial orchids. This is based upon an extensive literature (there are 639 references of which 194 are in languages other than English) which have been incorporated into a well-structured and readable book by an author who has herself been involved in orchid research for much of her career. I have no hesitation in recommending this book unreservedly to all interested in orchids who want to know more about the biology and development of these fascinating plants.

T. C. E. Wells

Flora silvestres de Baleares. A. M. Romo. Pp. 412. Editorial Rueda, Madrid. 1994. Price 3,500 pesetas [c. £14.00]. ISBN 84–7207–073–5.

Billing itself as the result of recompiling data from previous works, together with the results of numerous field excursions, Dr Romo's work has a number of good features. Of course, such an opening statement implies there are bad features too.

First the good news. Written entirely in Spanish, the book is clearly set out and very easy to use. The excursion-Flora style provides the standard information one expects in such a work: keys down to subspecies, brief diagnostic text plus notes on ecology, distribution, etc. All good, solid stuff, including some new and previously unpublished data. The illustrations are also good and there are lots of them. Those accompanying the species descriptions consist of line drawings by Eugeni Sierra. The introductory sections are illustrated with numerous colour photographs and include a brief history of botanical exploration in the archipelago, the origin and characteristics of the Balearic flora and lists of rarities (with I.U.C.N. categories). The chapter on botanically interesting localities details 70 sites throughout the islands and what plants to expect there. It will be of particular interest to the first-time visitor.

Set against this, the book has a number of bad points. New combinations are scattered through the text, all of them baldly presented. I prefer such novelties to be published separately, together with a clear exposition of the author's reasons for making such changes. Nowhere are the taxa numbered so it can be irritating locating them without resorting to the index. The numbering and captioning of plates is a little eccentric, as is the use of fonts to convey information. For example, I could not discover what, if any, reason attaches to the italicisation of some names and not others. This sort of mystery nags at the user.

For botanists wishing to identify Balearic plants in the field the best alternative up to now has been Elspeth Beckett's work giving keys to the flora. This is, initially, a more attactive prospect for

British botanists because it is written in English but Romo's book is a superior tool. I would reassure anyone worried about coping with the Spanish text. This book is written simply and clearly, and anyone familiar with Floras or field guides should have no problems getting the full benefit of this volume.

J. R. Press

An illustrated survey of orchid genera. T. & M. Sheehan. Pp. 421. Cambridge University Press, Cambridge. 1995. Price £60.00. ISBN 0–521–48028–0.

For over a quarter of a century Marion Sheehan's award-winning paintings of orchids have adorned the pages of the *American Orchid Society Bulletin* in the series entitled "Orchid Genera Illustrated". Each of her paintings depicts a representative of the featured genus with added details of the column, pollinarium and other critical features. The text by her husband, Tom, provides a breakdown of the features that aid identification and distinguish that genus from its allies, its systematic position and cultural details. This useful format has been lifted in toto for this book, the second compendium of their work to appear following their successful *Orchid genera illustrated* (1979, 1984).

This new work greatly expands the coverage of their earlier publication. The introductory chapters include discussions of "What is an orchid?" and orchid classification together with a reproduction of Robert Dressler's classification of the family as outlined in the recent *Phylogeny and classification of the orchid family* (1993). The main bulk of the text is, however, taken up by an alphabetic treatment of the genera dominated by Marion Sheehan's fine illustrations. The coverage is broad but far from comprehensive, 158 of perhaps 750 genera are treated here. These include the majority of the genera that are commonly found in cultivation and a few that are decidedly rare, such as *Ceratocentron, Psychilis* and *Sobennikoffia*. The absences that I have noted include interesting genera such as *Eulophiella*, *Grammangis*, *Oeonia* and *Cryptopus* but that is probably because I have just returned from Madagascar where all are endemic.

An illustrated survey of orchid genera is a welcome addition to the orchid literature and is timely in focusing attention upon generic limits, which I think will be one of the major areas of scientific interest in the family over the next few years. It is well produced, clearly laid out and attractively presented. This is reflected in the relatively high price of the book which will, I hope, not deter readers from adding it to their orchid library.

P. J. Cribb

Bracken: an environmental issue. Edited by R. T. Smith & J. A. Taylor. Pp. vii + 228. Special Publication no. 2, International Bracken Group, Leeds. 1995. Price £29.95 incl. p. & p. ISBN 0–9525505–0–4. Obtainable from Working Papers Secretary, School of Geography, University of Leeds, Leeds LS2 9JT.

This substantial book contains 42 contributions to an international conference ("Bracken 94", the third in an on-going series) held at Aberystwyth in July 1994. Bracken creates serious problems in many parts of the world and much research has been focused upon it from a variety of disciplines. This symposium volume offers a fascinating compilation of accounts of the present state of numerous lines of investigation, and of work in progress. The list of authors contains 71 names.

The book gathers in accessible form a wealth of information and ideas of interest and value to botanists as well as ecologists, agriculturists, rural economists, land managers, conservationists and those concerned with human and animal health. The world-wide dimension is represented by papers from the Netherlands, Bulgaria, U.S.A., Costa Rica, Brazil and Australia. In a brief review only a broad outline of the contents can be given, and it is not possible to comment on individual contributions, many of considerable scientific and practical merit.

"Bracken" is still a convenient inclusive name, but the taxonomic complex which it embraces has been shown to include several species, subspecies and varieties. These are described briefly in the

first paper, and their evolution, global distribution and genetics are discussed in other chapters of the first section, several adopting a molecular approach. Next, physiological and ecological topics are introduced, ranging from the cycling of radio nuclides in bracken stands to remote sensing and the modelling of bracken encroachment using G.I.S. A section of five papers on the effects of climate on growth and sporulation follows, opening up the possibility of predicting consequences of changes in climate and land use. Reports of important work on the carcinogenic and toxic properties of bracken constitute a further section, which also includes a useful account of its role in the ecology of Lyme disease. The last main group of 15 papers is devoted to bracken control and the management of cleared areas. Included here is reference to the positive contribution of some types of bracken communities to nature conservation, for example by maintaining habitats for the food plants of some rare butterflies.

The papers are all short and concise, most of them 2–6 pages in length. They provide stimulating résumés of research and, while some require specialist knowledge for full appreciation, they present a comprehensive and readable portrait of a taxon which must rank among those having received most attention over a considerable period. Despite this, however, it is shown that in parts of Britain bracken is still advancing at rates beyond the scope of current efforts to arrest its spread, and the epilogue makes a strong case for continued research to find new and improved methods of control.

C. H. Gimingham

Managing habitats for conservation. Edited by W. J. Sutherland & D. A. Hill. Pp. 399. Cambridge University Press, Cambridge. 1995. Hardback £55.00, ISBN 0–521–44260–5. Paperback £17.95, ISBN 0–521–44776–3.

This book brings together advice on the management of those habitats found in Britain, including farmland and urban sites which are not always recognised as worthy of consideration. With 27 authors there is inevitably a wide variation in writing style which is good, but there is also a very broad range in treatment which is less helpful. For example, the commendable use of boxes to highlight succinct examples of management practices does not occur in all chapters. The introduction to each habitat varies from short and pithy to long winded accounts better suited to ecological texts than a book on practical management. In this connection, most of the chapters have a good reference list where the *British plant communities* volumes receive a mention where appropriate. A land manager could do worse than start at the uplands chapter, where the style is concise, followed by the woodland chapter where for the first time we are told, "We cannot give guidance on stocking rates". Oh that this sentence was in every chapter where grazing is an option. Good managers should wear out the soles of their boots long before the seat of their trousers. Most managers are often confronted by the problem of control versus eradication where invasive or aggressive species are concerned, but in general there is little discussion on this subject. One general subject often overlooked, but well treated here, is restoration management versus permanent management.

The book contains 13 chapters, a list of useful addresses and an index. The first three chapters are by way of an introduction to matters pertaining to all the following chapters which cover the habitats. The introductory chapters cover principles of ecological management, and management planning and access. All offer very useful information but the oft trailed soil fertility and species diversity theory is perpetuated. A number of management mistakes would be avoided if the concept of varying levels of natural soil fertility giving rise to differing levels of species diversity were accepted. The problem for nature conservation is not natural high soil fertility but enforced high fertility by the addition of chemicals. If this fact is realised we will no longer need statements like "*Deschampsia flexuosa* is a nitrophilous grass" and "The ancient flood plains contained few species adapted to these conditions". However, the principles are well laid out and clearly stated, as is the chapter setting out management plans where good practical sense pervades although, after 30 years wandering around nature reserves, it is not stopping monitoring which is the problem, but keeping it going. Managers change frequently and that great curse of land management, the office, exerts an ever increasing deterrent effect.

The coastal section has good advice to offer on sand dunes and salt marshes. Presumably for

completeness, the open sea and rocky shores are included but, as that eleventh century regal researcher proved, the sea is not amenable to control. The aquatic environment is divided between two chapters, with rivers and linear bodies in one and lakes and ponds in the other. The rivers account is very well illustrated with well chosen photographs and figures, but are there no useful references to complement this subject? The lakes account is well written although a few technical terms surface from time to time. There is a good box on pond creation.

The fens and bogs chapter is full of good advice but the chapter is primarily divided up on management lines making it tedious to follow through management options for a given habitat. Few, if any, sites will encompass both fen and acid bog. Reed beds are singled out for special attention. The authors use the National Vegetation Classification to describe the communities but in passing it should be noted that Reed-Milk Parsley is not a new plant but a community and therefore better written as Reed/Milk Parsley. The grassland chapter makes no reference to current work on communities and as a result space is taken up with rather out-of-date descriptions. The management options are adequately dealt with but the fact that most British grassland can be maintained either by cutting or grazing is not brought out.

There is a chapter on management of farmland which should be read by managers with reserves adjacent to arable farms or which may have an ex-arable field within the reserve. However in the latter case please ignore the suggested planting of exotics. It would have been helpful to have noted that there is no herbicide which is specific in the botanical sense—the trade use the word specific to mean the herbicide was selected to kill that species regardless of its effect on others.

The lowland heaths chapter is a good balance of control of aggressive species and standard management options for heathland. Surprisingly, there is no mention of Alex Watt's long term work on the Breck. Both the uplands chapter and that on woodlands are well balanced and informative on various aspects of management. The urban habitat concludes the book and, naturally, concentrates on giving advice on restoration and how to integrate wildlife and people. The statement that horse grazing-of rough pastures may lead to *Caltha palustris* taking over is surely a mistake.

All in all a book well worth having and in the soft backed edition affordable by most. Around about a gallon of beer!

D. A. Wells

Flora of North Aberdeenshire. D. Welch. Pp. iv + 184. Privately published, Banchory. 1993. Price £24.00. ISBN 0–9519889–05.

North Aberdeenshire has been amongst the least well-recorded vice-counties although it has had the benefit of some excellent early work by G. Dickie and J. W. H. Trail and more recent efforts by amateurs, particularly Miss M. McCallum Webster, during the B.S.B.I. mapping scheme. The author has worked in North Aberdeenshire since 1968 and has made a huge contribution with his own field work, which has included re-recording all the many squares which are shared with other vice-counties because the B.S.B.I. scheme cards did not make clear to which vice-county the records belonged.

Between 1950 and 1992, 833 species and hybrids were recorded in North Aberdeenshire and a further 102 microspecies including 50 of *Taraxacum*, 24 of *Rubus fruticosus* and 12 of *Hieracium*. This makes North Aberdeenshire a relatively species-poor vice-county. The distribution of the species is presented in the Flora on a 10-km square basis and not by tetrads because of the chronic shortage of active botanists in north east Scotland generally.

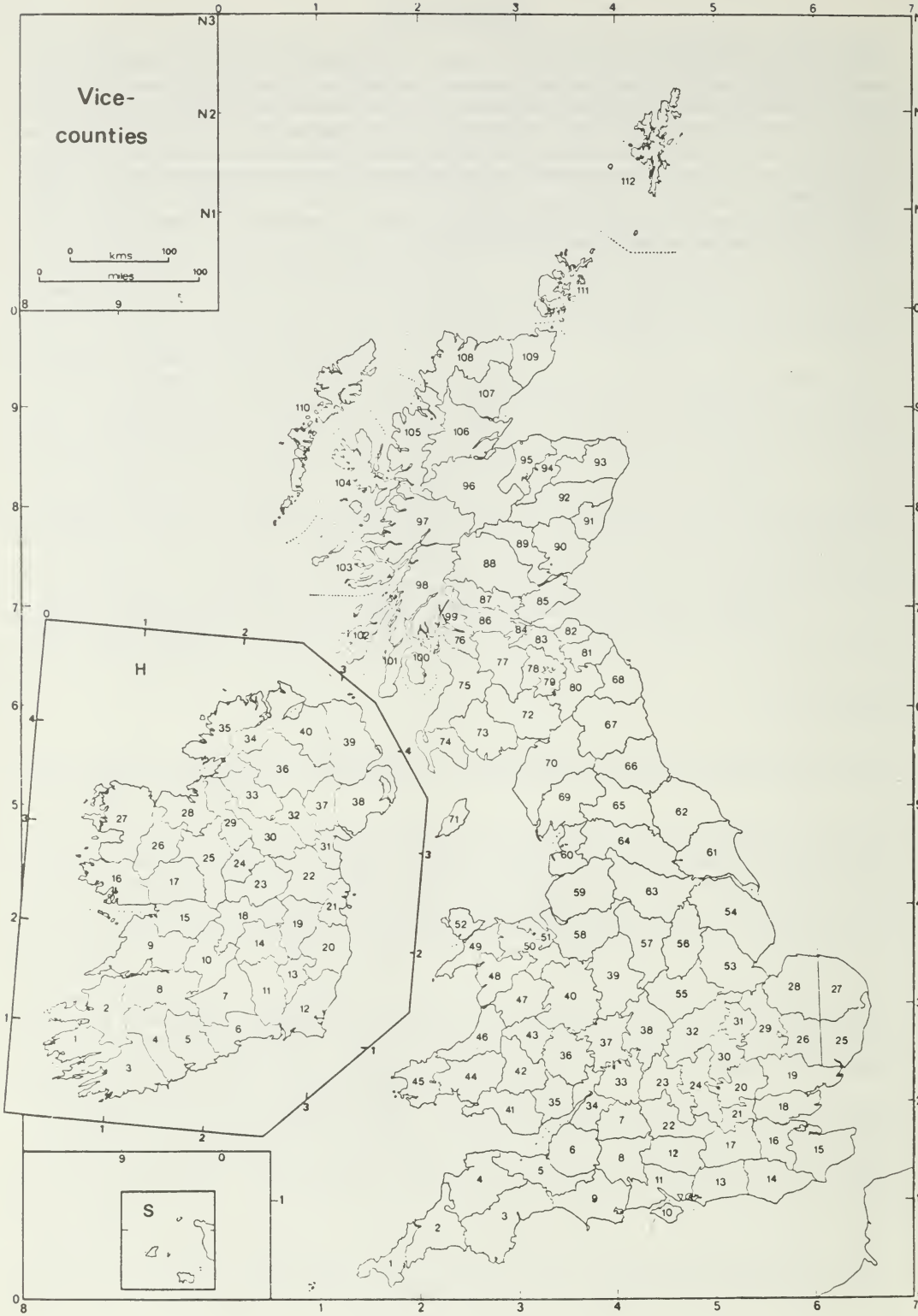
The first part of the book includes a chapter on factors influencing the flora which has a very useful account of human geography, climate, geology, soils and farming. This is followed by descriptions of the plant communities, which are not related to the National Vegetation Classification but are nevertheless informative. There follows a brief history of botanical recording in the vice-county, after which is the main body of the book, an account of all the known vascular species and microspecies.

Not everyone will like the appearance of the book with its A4 format, soft covers, and the rather crude type face which is oddly smaller in the chapter on plant communities. Although there is the attractive luxury of ten colour plates—unfortunately the two on the front cover are uncaptioned – a

better photograph should have been obtained for the Melancholy Thistle (*Cirsium heterophyllum*), and the Corn Marigold (*Chrysanthemum segetum*) is out of focus. I would like to have seen a little more emphasis paid to the ultramafic (serpentine) area of the vice-county. This is important in a British context with the Hill of Towanreef having the largest mainland area of the debris habitat. The debris is also unusually accessible, and whilst it lacks any outstanding rarities, it is a very good example of its type and features what is probably the second most magnesium-toxic soil in the British Isles.

My criticisms must be regarded as minor. This is a good book which should find a place on the shelves of all those interested in the Scottish flora.

J. Proctor


Vice-
counties
0 kms 100
0 miles 100
H
S

NAMES OF VICE-COUNTIES IN *WATSONIA*

ENGLAND, WALES AND SCOTLAND

1. W. Cornwall
1b. Scilly
2. E. Cornwall
3. S. Devon
4. N. Devon
5. S. Somerset
6. N. Somerset
7. N. Wilts.
8. S. Wilts.
9. Dorset
10. Wight
11. S. Hants.
12. N. Hants.
13. W. Sussex
14. E. Sussex
15. E. Kent
16. W. Kent
17. Surrey
18. S. Essex
19. N. Essex
20. Herts.
21. Middlesex
22. Berks.
23. Oxon
24. Bucks.
25. E. Suffolk
26. W. Suffolk
27. E. Norfolk
28. W. Norfolk
29. Cambs.
30. Beds.
31. Hunts.
32. Northants.
33. E. Gloucs.
34. W. Gloucs.
35. Mons.
36. Herefs.
37. Worcs.
38. Warks.
39. Staffs.
40. Salop
41. Glam.
42. Brecs.
43. Rads.
44. Carms.
45. Pembs.
46. Cards.
47. Monts.
48. Merioneth
49. Caerns.
50. Denbs.
51. Flints.
52. Anglesey
53. S. Lincs.
54. N. Lincs.
55. Leics.
55b. Rutland
56. Notts.
57. Derbys.
58. Cheshire
59. S. Lancs.
60. W. Lancs.
61. S.E. Yorks.
62. N.E. Yorks.
63. S.W. Yorks.
64. Mid-W. Yorks.
65. N.W. Yorks.
66. Co. Durham
67. S. Northumb.
68. Cheviot
69. Westmorland
69b. Furness
70. Cumberland
71. Man
72. Dumfriess.
73. Kirkcudbrights.
74. Wigtowns.
75. Ayrs.
76. Renfrews.
77. Lanarks.
78. Peebless.
79. Selkirks.
80. Roxburghs.
81. Berwicks.
82. E. Lothian
83. Midlothian
84. W. Lothian
85. Fife
86. Stirlings.
87. W. Perth
88. Mid Perth
89. E. Perth
90. Angus
91. Kincardines.
92. S. Aberdeen
93. N. Aberdeen
94. Banffs.
95. Moray
96. Easterness
96b. Nairns.
97. Westerness
98. Main Argyll
99. Dunbarton
100. Clyde Is.
101. Kintyre
102. S. Ebudes
103. Mid Ebudes
104. N. Ebudes
105. W. Ross
106. E. Ross
107. E. Sutherland
108. W. Sutherland
109. Caithness
110. Outer Hebrides
111. Orkney
112. Shetland

IRELAND

H1. S. Kerry
H2. N. Kerry
H3. W. Cork
H4. Mid Cork
H5. E. Cork
H6. Co. Waterford
H7. S. Tipperary
H8. Co. Limerick
H9. Co. Clare
H10. N. Tipperary
H11. Co. Kilkenny
H12. Co. Wexford
H13. Co. Carlow
H14. Laois
H15. S.E. Galway
H16. W. Galway
H17. N.E. Galway
H18. Offaly
H19. Co. Kildare
H20. Co. Wicklow
H21. Co. Dublin
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H25. Co. Roscommon
H26. E. Mayo
H27. W. Mayo
H28. Co. Sligo
H29. Co. Leitrim
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H33. Fermanagh
H34. E. Donegal
H35. W. Donegal
H36. Tyrone
H37. Co. Armagh
H38. Co. Down
H39. Co. Antrim
H40. Co. Londonderry

BOTANICAL SOCIETY OF THE BRITISH ISLES (B.S.B.I.)

The B.S.B.I. was founded in 1836 and has a membership of 2,700. It is the major source of information on the status and distribution of British and Irish flowering plants and ferns. This information, which is gathered through a network of county recorders, is vital for the conservation of the plants and is the basis of the *Red data books* for vascular plants in Great Britain and Ireland. The Society arranges conferences and field meetings throughout the British Isles and, occasionally, abroad. It organises plant distribution surveys and publishes plant atlases and handbooks on difficult groups such as sedges and willows. It has a panel of referees available to members to name problem plants. Through its Conservation Committee it plays an active part in the protection of our threatened plants. It welcomes all botanists, professional and amateur alike, as members.

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Scope. Authors are invited to submit Papers and Notes concerning British and Irish vascular plants, their taxonomy, biosystematics, ecology, distribution and conservation, as well as topics of a more general or historical nature. Authors should consult the Hon. Receiving Editor for advice on suitability or any other matter relating to submission of manuscripts.

Papers and Notes must be submitted *in duplicate*, typewritten on one side of the paper, with wide margins and double-spaced throughout. Submission of copy on computer discs is acceptable but must also be accompanied by two hard copies of the text, double spaced throughout.

Format should follow that used in recent issues of *Watsonia*. Underline where italics are required. Names of periodicals should be given in full, and herbaria abbreviated as in *British and Irish herbaria* (Kent & Allen 1984). The Latin names and English names of plants should follow the *New Flora of the British Isles* (Stace 1991). Further details on format can be obtained from the Hon. Receiving Editor.

Tables, figure legends & appendices should be typed on separate sheets and attached at the end of the typescript.

Figures should be drawn in black ink or be laser-printed and identified in pencil on the back with their number and the author's name. They should be no more than three times final size, bearing in mind they will normally be reduced to occupy the full width of a page. Scale-bars are essential on plant illustrations and maps. Lettering should be of high-quality and may be done in pencil and left to the printer. Black and white photographs can be accepted if they assist in the understanding of the article.

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Plant Records: the appropriate vice-county recorder, who should then send them to C. D. Preston, Biological Records Centre, Monks Wood, Abbots Ripton, Huntingdon, PE17 2LS.

Obituaries: Dr J. R. Akeroyd, Lawn Cottage, Fonthill Gifford, Tisbury, Wiltshire, SP3 6SG.

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Watsonia

September 1996 Volume twenty one Part two

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